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ABSTRACT

The second annual Rural Technology Institute (RTI) was a 3-day training event designed to help rural educators increase their school's or district's capacity to use technology for learning. Three strands focused on technology issues within the areas of administration, curriculum, or infrastructure support. Participating schools or districts were asked to send a team of three individuals so that one representative could attend each strand. This was based on research that suggests that the most useful school technology programs are planned and implemented jointly by administrators, teachers, and information technology staff. Thirty-seven people attended, representing 11 school districts and 5 states (Colorado, Kansas, Missouri, Nebraska, and Wyoming). Participants attended a number of general sessions covering topics such as calculating the total cost of ownership within a technology program, distance learning demonstrations, information regarding the Missouri Virtual School, and a discussion on filtering and Internet safety. In addition, each strand included a number of specialized sessions. The administration strand included a briefing on federal and state policy, NETS*A technology standards for administrators, copyright and fair use guidelines, and data-driven decision making. The curriculum strand focused on curriculum resources, technology-rich curriculum unit design, and professional development options. The infrastructure strand addressed technology resources, network security and collaboration, licensing, and inventory issues. There was also a small vendor's fair featuring a number of software and Web sites that offer technological solutions for teaching and learning. (Author/TD)

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2002 Annual
Rural Technology Institute

July 29-31, 2002

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Lawrence, Kansas

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SUMMARY OF RURAL TECHNOLOGY INSTITUTE

Lawrence, KS - July 29-31, 2002

Regional Educational Laboratory
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September 2002

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BACKGROUND

Rural schools face unique challenges when integrating technology into their classrooms and curriculum, in part, due to isolation and the lack of available resources. In an effort to assist rural K-12 schools in addressing these challenges, the Rural Technology Institute (RTI) was first launched in summer 2001 to provide hands-on training to help rural educators increase their school's or district's capacity to use technology for learning. This report summarizes the second annual RTI event, held July 29-31, 2002, in Lawrence, Kansas.

This three-day event brought together school teams comprised of administrators, curriculum specialists, and instructional technology members. The Institute was organized into three strands that focused on technology issues within the specialty areas of administration, curriculum, or infrastructure support. General sessions also were held which served as common, shared experiences for all participants. Discussions and activities were intended to encourage participants to investigate cost-effective approaches to implementing, maintaining, and expanding technology programs designed to enhance student learning.

PARTICIPANTS

Educators from rural K-12 public schools throughout McREL's seven-state region were invited to attend the Rural Technology Institute. Participating schools or districts were asked to send a team of three individuals so that one representative could attend each strand. This design feature was a direct result of our research and experience, which suggests that the most dynamic and useful school technology programs are planned and implemented jointly by administrators, teachers, and information technology staff.

A total of 37 people attended the RTI, representing 11 school districts and five states (Colorado, Kansas, Missouri, Nebraska, and Wyoming) in the McREL region. Participants also included a team from an intermediate service unit in Nebraska, and a team representing the Center for Scientific Research and Education from Southwest Missouri State University. A list of participants is provided in Appendix A.

SESSIONS AND ACTIVITIES

Participants attended a number of general sessions, covering topics such as TCO (calculating the total cost of ownership within a technology program), distance learning demonstrations and information regarding the Missouri Virtual School, and a fishbowl discussion that considered different viewpoints on filtering and Internet safety. In addition, each strand included a number of specialized sessions. The *administration strand* included a briefing on federal and state policy, NETS*A technology standards for administrators, copyright and fair use guidelines, and data-driven decision making. The *curriculum strand* focused on curriculum resources, technology-rich curriculum unit design and professional development options. The *infrastructure strand* addressed technology resources, network security and collaboration, licensing, and inventory issues. The complete Institute agenda is provided in Appendix B.

The Institute also included a small vendor's fair where a number of software and Web sites were featured that offer technological solutions for teaching and learning. Appendix C provides a brief description of the vendor fair participants. AlphaSmart, Inc. donated an AlphaSmart 3000 appliance for a participant drawing at the close of the Institute. Learning Services Inc. donated *Kidspiration* and *Inspiration* demonstration discs for all participants.

The Institute closed with each team developing an action plan of next steps to take when they returned to their district. Team members attending the three strands engaged in conversation to complete an action plan template, which included space to list goals, activities, and resources needed to meet the goals.

PARTICIPANT REMARKS

At the close of the Institute, participants were asked to rate the extent to which the following six Institute objectives were important to them and the extent to which each was accomplished:

1. Increase understanding about the issues involved in designing and implementing technology programs
2. Promote valuable conversations among job-specific participants on important topics around technology
3. Promote team building among participants through discussions and activities
4. Provide opportunities for participants to engage in hands-on activities using software that is of value to educators
5. Provide information about technology-related resources available to rural educators
6. Provide the opportunity to discuss specific technology concerns or issues

All six objectives were rated as important; each received a mean rating above 4.0 on a five-point scale. Increasing understanding about technology issues and providing opportunities to engage in hands-on activities were rated as the most important. Participants' assessment of the extent to which the objectives were met was highest for Objective 3 (team building), Objective 4 (hands-on with software) and Objective 5 (valuable rural information).

Participants reported that the Institute and Institute materials were of high quality, that the event was effective in addressing the concerns of rural educators, and that the event provided them with sufficient opportunities for input and interaction. This was true of participants in all three strands. Participants indicated that they expected to both use and share information acquired during the event.

Participants were asked to provide optional comments at the conclusion of the Institute. Here are a few of their quotes:

"What a great educational opportunity for educators. Every educator should attend this workshop to learn about the exceptional educational opportunities offered through technology innovation. An outstanding workshop – one of the best I have ever attended."

"As a second year participant and a pre-service teacher, the opportunities presented at the conference have raised my level of consciousness on educational technology. I feel I will use this information to not only enhance my students' learning but also as a tool to make my job as a teacher more effective."

"The RTI is an excellent forum for rural educators, and those responsible for rural education to network as well as be informed on current and emerging technologies, software and best practices."

"I am very impressed with the quality of materials presented. The presenters were extremely knowledgeable and conducted the workshops in a very professional manner."

"Excellent time for our district team to have a common experience and time for processing and planning for the next year. Resources provided gave plenty of food for thought."

CONCLUSIONS

The Rural Technology Institute was well received by participants. Individual comments indicated that participants learned a great deal from attending the event and that they appreciated this opportunity provided by McREL. Participants' comments also indicated that some would have liked additional opportunities to engage in discussions. Based on the statistical findings and comments, it is anticipated that McREL will incorporate additional time for discussions between presenters and participants and among participants to further enhance their understanding of topics covered and to facilitate information sharing.

APPENDIX A: PARTICIPANT LIST

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APPENDIX B: MEETING AGENDA

	MONDAY, JULY 29		
8:30 – 9:00	*Continental Breakfast*		
9:00 – 10:00	**Welcome, Introductions and Evaluation Review**		
10:00 – 10:15	*Break*		
10:15 – 12:15	**Total Cost of Ownership**		
12:15 – 1:15	*Lunch*		
	ADMINISTRATION STRAND	*CURRICULUM STRAND*	*INFRASTRUCTURE STRAND*
1:15 – 3:15	**Administrator Resources** **NETS*A**	**Curriculum Unit Design** **Curriculum Resources**	**Technology Resources** **Technology Q&A**
3:15 – 3:30	*Break*		
3:30 – 4:00	**Overview of McREL Online Resources**		**Technology Q&A (cont.)**
4:00 – 4:30	**Day 1 Evaluation**		

TUESDAY, JULY 30			
8:30 – 9:00	*Continental Breakfast*		
9:00 – 9:45	**Fishbowl Session**		
9:45 – 10:00	*Break*		
	ADMINISTRATION STRAND	*CURRICULUM STRAND*	*INFRASTRUCTURE STRAND*
10:00 – Noon	**Policy Briefing**	**Distance Education Marco Polo**	**Network Lab security collaborative networking licensing and inventory tools**
Noon – 1:00	*Lunch*		
1:00 – 4:00	**Data-Driven Decision Making for Administrators Distance Education**	**HPRTEC Resources Professional Development**	**Distance Education Network Lab (cont.)**
4:00 – 4:30	**Day 2 Evaluation**		

Note: On Tuesday, afternoon breaks will be taken at the discretion of the members of each strand

WEDNESDAY, JULY 31	
8:30 – 9:00	*Continental Breakfast*
9:00 – 11:00	**Vendor Fair and Demonstrations**
11:00 – 11:45	**- Pulling It All Together –** School/District Team Planning Session
11:45 – Noon	**Final Evaluation** **Drawing for AlphaSmart Computer** (must be present to win)
Noon – 1:00	*Lunch and Adjourn*

Note: On Tuesday, afternoon breaks will be taken at the discretion of the members of each strand

APPENDIX C: VENDORS LIST

MarcoPolo: Online Internet Content for the Classroom

MarcoPolo is a partnership between the MCI Worldcom Foundation and seven leading educational organizations that has yielded quality standards-based Internet content for the classroom. The content is accessible through six discipline-specific educational web sites and is available to educators without cost. The MarcoPolo web site also is a valuable educational resource on its own, offering teachers online tours of MarcoPolo and the partner sites, an explanation of the program's philosophy, constantly updated measurement, evaluation data and other useful educational material, and FREE professional development

Fresh Perspectives
37 Verde Lane
Durang, CO 81301
970.247.0028
http://www.marcopolo-education.org/

Missouri Virtual School Distance Education Demonstration

A team of undergraduate and graduate pre-service students from the Missouri Virtual School will present current and emerging educational technologies for distance learning. The presentation will illustrate the convergence of asynchronous and synchronous online pedagogical modalities, synthesized with interactive television, live broadcasts, and traditional classroom experiences.

Center for Scientific Research and Education
Southwest Missouri State University
901 South National
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http://www.smsu.edu

High Plains Regional Technology in Education Online Resources

HPR*TEC will provide a guided tour of its online resources. **RubiStar** is a tool to help the teacher who wants to use rubrics but does not have the time to develop them from scratch. **Think Tank** is a tool designed to help students from grades four through eight develop research topics for reports and projects. Think Tank is linked with another HPR*TEC product, **NoteStar**. Once a student has developed his or her topics, the student may export these topics to NoteStar. The only requirement is that the student's instructor has already set up a NoteStar Account for that student. **Casa Notes** is designed to allow teachers to quickly make, and customize, typical notes that are sent home to parents or given to students. Teachers can select whether the notes should be in English or in Spanish.

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McREL Online Classroom Projects

McREL provides standards-aligned and technology-rich classroom materials derived from a variety of content-rich projects. Come visit and browse samples of materials based on NASA's Genesis and Deep Impact missions: modules with teacher guides, student activities, student texts, and, of course, technology applications for each module. Supplemental materials include fact sheets, educational videos, a cleanroom interactive field trip, and interactive periodic table modeling software. Also obtain information on the Earth System Science Course for Middle School Teachers, a 16-week professional development online course developed by the Center for Education Technologies (CET), and facilitated by educators at Mid-continent Research for Education and Learning.

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http://genesismission.jpl.nasa.gov

McREL extends a special thanks to Linda Sharp of AlphaSmart, Inc., a leading provider of technology solutions for education, focused on reducing the cost and complexity of computing. Thanks, Linda, for your generous donation of an AlphaSmart 3000, to be awarded to a lucky RTI participant on Wednesday, July 31.

AlphaSmart, Inc
973 University Ave.
Los Gatos, CA 95032
888.274.0680
http://www.alphasmart.com

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Notes

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July 29, 2002

Dear Rural Educator:

On behalf of McREL, its Board of Directors, the McREL technology team, and the staff of the University of Kansas School of Education, I want to welcome you to the second annual Rural Technology Institute. This Institute is supported by our Regional Educational Laboratory contract with the Department of Education, which serves educators in seven states: Colorado, Kansas, Missouri, Nebraska, North Dakota, South Dakota, and Wyoming.

We have gathered research, tapped our own expert resources, and worked with rural educators throughout the Midwest in an effort to design practical sessions that will help you strengthen your ability to implement effective technology in your own districts, schools, and classrooms. I trust you will find this an exciting opportunity to build your individual and team technology skills. And I'm confident that the Institute will spark your interest in harnessing the power of technology in your classrooms and the teaching and learning process.

The two and-a-half days are filled with practical information, hands-on learning experiences, and networking opportunities. On Wednesday, you'll have time to talk with vendors, meet with the RTI presenters in an informal setting to discuss issues specific to your school, and to bring your thoughts and experiences together in the closing activity.

We encourage you to take a few minutes to review the McREL Technology Solutions materials in the enclosed blue folder. Much of the material presented during this Institute is part of that larger program, which is available to schools and districts across the nation.

Enjoy your stay with us and, please, share your thoughts, ask questions, and make suggestions to any of the McREL staff members, all of whom will be sporting McREL name badges. Thank you for coming to McREL's second annual Rural Technology Institute.

Sincerely,

Louis F. Cicchinelli, Ph.D.
Associate Vice President and Deputy Director

P.S. We encourage you to stay to the very end of the Institute, as we will be giving away an AlphaSmart computer, generously donated by AlphaSmart of Cupertino, California.

Mid-continent Research for Education and Learning

Dedication

The 2002 Annual Rural Technology Institute is respectfully dedicated to the memory of Pat McCartney, McREL's Director of Technology and founder of the RTI.

Pat died May 23, 2002, following a long illness. She joined McREL in 1998 and was named technology director in 1999. Among Pat's many accomplishments during her tenure at McREL include the development and implementation of the McREL Technology Initiative (MTI), a comprehensive program designed to help K-12 schools effectively employ technology throughout all grades and academic departments.

Consistent with that goal, Pat also developed the RTI: she believed that an intensive, team-based approach is the most effective way to address the unique technology needs of rural educators.

Before joining McREL, Pat spent 25 years as a teacher and educational technologist, teaching from kindergarten through graduate school. She had Masters degrees in English and Computers in Education, and at the time of her death was near completion of her Ph.D. in Educational Technology from the University of Denver.

Working in all levels of education from classroom teacher to technology consultant for the Colorado Department of Education and curriculum director for education companies, Pat was experienced at designing and implementing effective technology programs for classrooms, schools, and districts.

We, her colleagues and friends, respectfully dedicate this year's Institute to the memory of a passionate, warm, and visionary educator who has inspired many through her example of a life committed to improving the quality of education for all children.

2002 Annual Rural Technology Institute Presenters, Speakers, and Staff

Carlisha Bell, Content Reviewer, High Plains R*TEC, recently graduated from the University of Kansas School of Education. Carlisha has participated in the inception and actual development of tools for the 4Teachers Team. She has also provided many professional development sessions as a means of aiding teachers in the process of technology integration.

Phone: 800.TEC.2001
Email: info@hprtec.org

Kathy Brabec, McREL Senior Consultant, is one of the key developers of the McREL Technology Initiative. Ms. Brabec has been involved in K-12 education since 1971. She has taught high school English, middle school Social Studies, and been an elementary and middle school media specialist. Kathy has been teaching technology classes at the college level to teachers since the early '80s. Before joining McREL, Kathy worked as a teacher technology trainer at the district level.

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Kevin Cooney, McREL Program Coordinator, has provided training and program support for McREL since 1997. Before joining McREL's Technology Department, Kevin served as conference coordinator for the 1998 and 1999 McREL Dimensions of Learning conferences. Kevin also has an M.A. in psychology and has worked with students as a counselor in elementary schools.

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Stan Dunlap, President, Fresh Perspectives, Durango, Colorado, has delivered over 250 professional development trainings for teachers and administrators, facilitated strategic and technology planning, generated over three million dollars in grant funds, designed and administered a Regional Professional Development Center, and served as a national Cadre Trainer for the "MarcoPolo - Internet Content For the Classroom" through the Worldcom Foundation.

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2002 Annual Rural Technology Institute Presenters, Speakers, and Staff

Kimberly Fisher, McREL Senior Consultant, is one of the key developers of the McREL Technology Initiative and has been involved in educational technology for over 20 years. Kimberly taught elementary school for seven years, then worked for a software company as a national trainer and instructional designer. Prior to joining McREL, she was a consultant for the Colorado Department of Education in areas including technology planning and grant administration.

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Email: kfisher@mcrel.org

Laura Lefkowits, McREL Director of Policy Initiatives, provides support for education policy development and governmental relations in the central region and nationally for McREL/ Laura has a masters in Public Policy and has worked in a variety of non-profit organizations throughout her career. She served as an at-large member of the Denver Public Schools Board of Education from 1995-1999.

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Ruby Severson, System Coordinator, Grand Mesa High School, Colbran, Colorado, has devoted her career to providing technology services to teachers and students . She has designed and installed network systems, taught advanced technology classes and helped develop a program that prepares high school students for careers using technology. Ruby has also played an integral part in the Technology in Education Conferences provided annually for teachers in Colorado and surrounding states.

Phone: 970.487-3576 Ext. 226
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Glen Taylor, McREL Information Systems Manager, has experience with installation and maintenance of a wide range of computer platforms, such as Novell Netware, Windows NT, and Macintosh OS. He also designed and installed network architecture for enterprise solutions. Glen is a Microsoft Certified Systems Engineer and Cisco Certified Network Associate. Glen is also a former K-6 classroom teacher.

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2002 Annual Rural Technology Institute Presenters, Speakers, and Staff

Jim Tice, Research Associate with the Southwest Missouri State University Missouri Virtual School, has been a practitioner of the integration of current and emerging technologies into the learning process throughout his 40 year career as a teacher and administrator in Missouri's rural schools. Since his retirement from public education in 1998 he has been actively focusing on distance learning in all of its modalities. This past school year MVS served 120 students in 12 districts in southwest Missouri through I-TV, asynchronous online delivery, and synchronous online delivery of math, science, and Spanish courses.

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2002 Annual Rural Technology Institute
Vendor's Fair Participants

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2002 Annual Rural Technology Institute
July 29-31, 2002, Lawrence, Kansas

	MONDAY, JULY 29		
8:30 – 9:00	*Continental Breakfast*		
9:00 – 10:00	Welcome, Introductions, and Evaluation Review		
10:00 – 10:15	*Break*		
10:15 – 12:15	Total Cost of Ownership		
12:15 – 1:15	*Lunch*		
	ADMINISTRATION STRAND	*CURRICULUM STRAND*	*INFRASTRUCTURE STRAND*
1:15 – 3:15	Administrator Resources NETS*A	Curriculum Unit Design Curriculum Resources	Technology Resources Technology Q & A
3:15 – 3:30	*Break*		
3:30 – 4:00	Overview of McREL Online Resources		Technology Q & A (cont.)
4:00 – 4:30	Day 1 Evaluation		

2002 Annual Rural Technology Institute
July 29-31, 2002, Lawrence, Kansas

	TUESDAY, JULY 30		
8:30 – 9:00	*Continental Breakfast*		
9:00 – 9:45	Fishbowl Session		
9:45 – 10:00	*Break*		
	ADMINISTRATION STRAND	*CURRICULUM STRAND*	*INFRASTRUCTURE STRAND*
10:00 – Noon	Policy Briefing	Distance Education Marco Polo	Network Lab • security • collaborative networking • licensing and inventory tools
Noon – 1:00	*Lunch*		
1:00 – 4:00	Data-Driven Decision Making for Administrators Distance Education	HPRTEC Resources Professional Development	Distance Education Network Lab (cont.)
4:00 – 4:30	Day 2 Evaluation		

Note: On Tuesday, afternoon breaks will be taken at the discretion of the members of each strand

2002 Annual Rural Technology Institute
July 29-31, 2002, Lawrence, Kansas

	WEDNESDAY, JULY 31
8:30 – 9:00	*Continental Breakfast*
9:00 – 11:00	Vendor Fair and Demonstrations
11:00 – 11:45	- Pulling It All Together – School/District Team Planning Session
11:45 – Noon	Final Evaluation Drawing for AlphaSmart Computer (must be present to win)
Noon – 1:00	*Lunch and Adjourn*

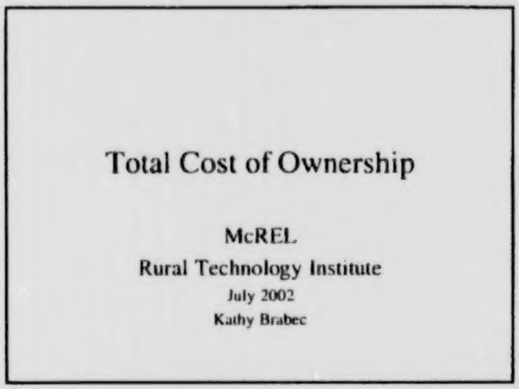
Notes

2

Total Cost of Ownership

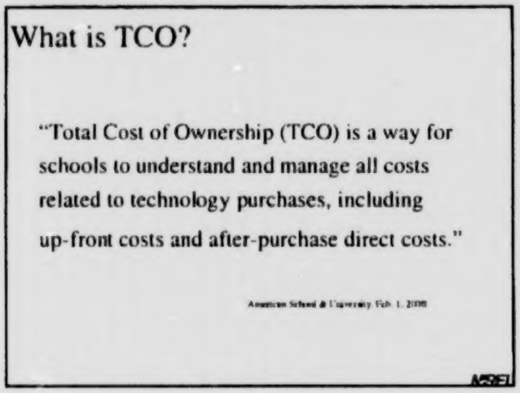
What it *really* costs to implement and maintain school technology services

Kathy Brabec, McREL
Monday, July 29, 2002



Total Cost of Ownership

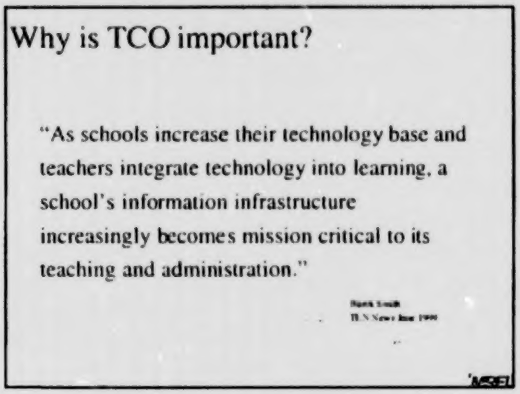
McREL
Rural Technology Institute
July 2002
Kathy Brabec



What is TCO?

"Total Cost of Ownership (TCO) is a way for schools to understand and manage all costs related to technology purchases, including up-front costs and after-purchase direct costs."

American School & University Feb. 1, 2000



Why is TCO important?

"As schools increase their technology base and teachers integrate technology into learning, a school's information infrastructure increasingly becomes mission critical to its teaching and administration."

[illegible]
[illegible]

Why is TCO important?

- Technology is mission critical
- Costs shifting from one-time capital funds to annual operating budgets
- Costs related to technology are often scattered throughout budget categories and levels

"If you're not going to depend on it, then you're not going to use it in a very meaningful way."

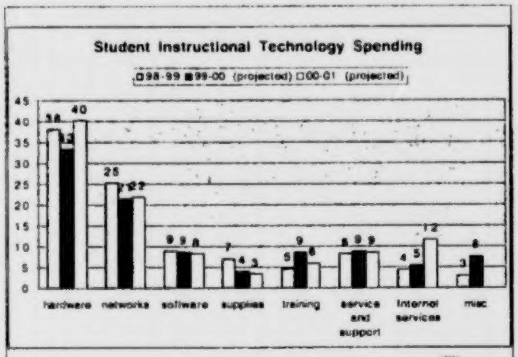
--Michael Sullivan
Executive Director
Agency for Instructional Technology
Bloomington, Ind.

Components of TCO

- Professional Development
- Support
- Software
- Hardware
- Replacement Costs
- Retrofitting
- Connectivity

Some general data...
...and caveats

- Much of the data is 3-5 years old
- Much of data reflects the time that LANs and WANs were being installed



QED

Some general data...

- 1998 Milken study of 1,990 districts in 21 states indicated school technology spending was:
  - 5.6% of capital budget
  - 3.4% of operating budget

Components of TCO

- Professional Development
- Support
- Software
- Hardware
- Replacement Costs
- Retrofitting
- Connectivity

Professional Development

- In '96 the Department of Education recommended 30% of technology budgets be spent on staff training and development
- In '98-'99, QED reported the average spent was 5%
- "The private sector is spending a dollar on training for every dollar of hardware and software."

Eliot Levinson and Dr. Jim Sutton
Converge

Professional Development

Enhancing Education Through Technology
(E^2T^2)

- $700.5 million in 2002
- State administered block grants
- 25% of local monies for professional development

Support

- In a '99 study, businesses generally had one support person for every 50-75 PCs. In education, it is somewhere around one for every 500
- In a '98 study, over 29% of respondents said one reason computers were sitting idle in schools was because they needed repair

---

Support in Rural Schools

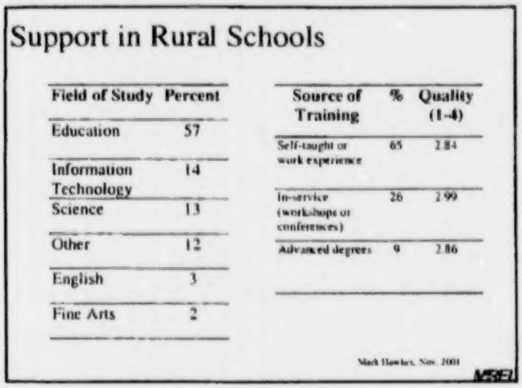
- Rural schools are more likely than urban to have computers in the classroom (87% vs 80%)
- Small schools are more likely than large to have computers in the classroom (87% of schools with enrollment under 300 vs 71% with enrollment over 1,000)

NCES, 2000

Support in Rural Schools

	Female	**Male**
Average Age	41.7	42.2
Average Salary	$30,631	$35,586
Gender	45%	55%

Mark Hawkins, Nov. 2001

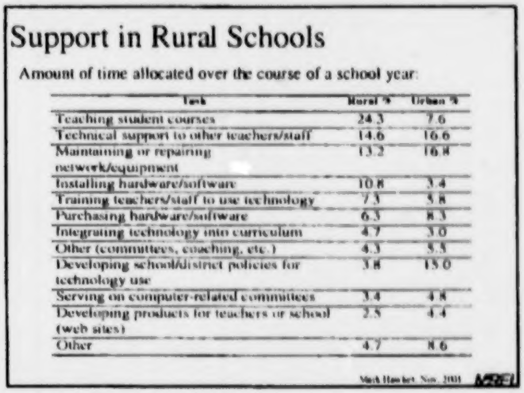


Support in Rural Schools

Field of Study	Percent
Education	57
Information Technology	14
Science	13
Other	12
English	3
Fine Arts	2

Source of Training	%	Quality (1-4)
Self-taught or work experience	65	2.84
In-service (workshops or conferences)	26	2.99
Advanced degrees	9	2.86

Mark Hawkes, Nov. 2001

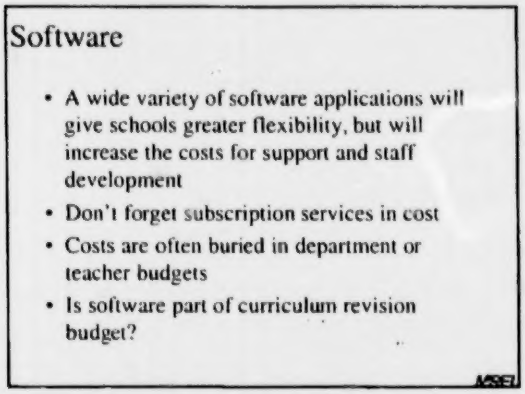


Support in Rural Schools

Amount of time allocated over the course of a school year:

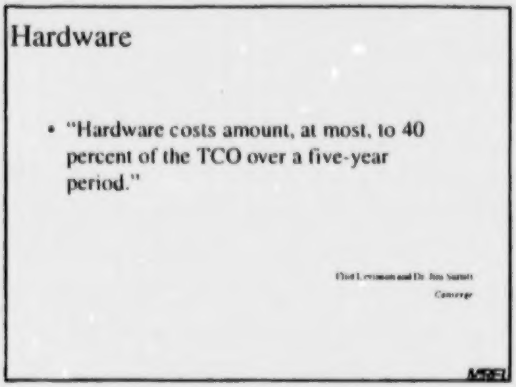
Task	Rural %	Urban %
Teaching student courses	24.3	7.6
Technical support to other teachers/staff	14.6	16.6
Maintaining or repairing network/equipment	13.2	16.8
Installing hardware/software	10.8	3.4
Training teachers/staff to use technology	7.3	5.8
Purchasing hardware/software	6.3	8.3
Integrating technology into curriculum	4.7	3.0
Other (committees, coaching, etc.)	4.3	5.5
Developing school/district policies for technology use	3.8	15.0
Serving on computer-related committees	3.4	4.8
Developing products for teachers or school (web sites)	2.5	4.4
Other	4.7	8.6

Mark Hawkes, Nov. 2001



Software

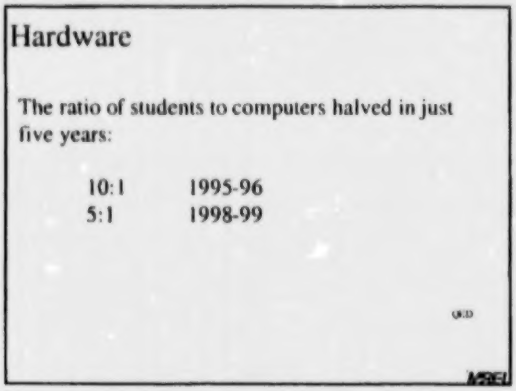
- A wide variety of software applications will give schools greater flexibility, but will increase the costs for support and staff development
- Don't forget subscription services in cost
- Costs are often buried in department or teacher budgets
- Is software part of curriculum revision budget?



Hardware

- "Hardware costs amount, at most, to 40 percent of the TCO over a five-year period."

Eliot Levinson and Dr. Jim Surratt
Converge

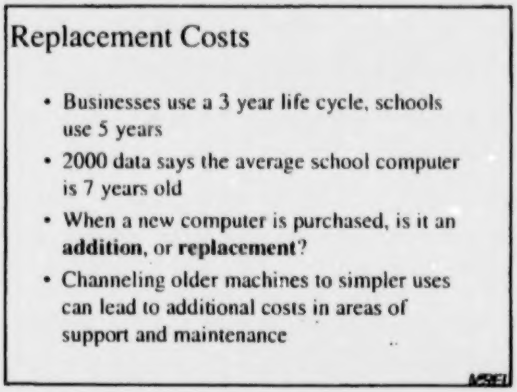


Hardware

The ratio of students to computers halved in just five years:

10:1	1995-96
5:1	1998-99

QED



Replacement Costs

- Businesses use a 3 year life cycle, schools use 5 years
- 2000 data says the average school computer is 7 years old
- When a new computer is purchased, is it an **addition**, or **replacement**?
- Channeling older machines to simpler uses can lead to additional costs in areas of support and maintenance

Retrofitting

- A '97 study of 30 Midwest construction projects estimated the following infrastructure costs:
  - $1,500/classroom new
  - $3,000/classroom renovate/modernize
- As use increases, retrofitting of current infrastructure may be necessary
  - Wireless
  - Routers
- HVAC and electrical are part of retrofitting

Connectivity

- As integration increases, so does need for bandwidth
- There is a convergence of digital voice, video and data technologies

Show Me the Money

TCO Team Activity

taking TCO TO THE classroom

A School Administrator s Guide To Planning for the Total Cost of New Technology

Copyright
Consortium for School Networking
July 2001

Acknowledgements

The Consortium for School Networking is a non-profit association that promotes the use of telecommunications to improve K-12 learning. Its members include state departments of education, state networks, school districts, schools, individuals and companies that are committed to this goal.

CoSN launched its Taking TCO to the Classroom project in 1999 to help school leaders understand the long-term costs involved in building and operating a network of computers. That way they will be able to budget adequately to cover all the associated costs and build and operate their networks in the most cost-efficient way to achieve their technology goals.

The project is made possible through the financial support of several corporate sponsors. However, CoSN is responsible for creating all the materials associated with the TCO project and retains editorial control over them. Sponsors provide input and feedback, but the ultimate responsibility for project materials remains with CoSN.

Throughout this project, CoSN has benefited from input supplied by staff members of the National School Boards Association, the Council of the Great City Schools, the American Association of School Administrators, and the Association of School Business Officials International. This revision of CoSN s first white paper on the topic was made possible by contributions from Intel Corp., Citrix Systems, Inc., Dell Computer Corp., NetSchools Corp., Sun Microsystems Inc., Chancery Software Ltd., eChalk LLC and National Semiconductor Corp. The white paper was prepared by Sara Fitzgerald of Funds For Learning, LLC, project director of Taking TCO to the Classroom.

Related materials continue to be updated, improved and posted on CoSN s TCO Web site, http://www.classroomtco.org.

For more information, contact CoSN, 1555 Connecticut Avenue NW, Suite 200, Washington, DC 20036. Phone: 202-466-6296. http://www.cosn.org. This white paper may be reproduced for use by non-profit educational organizations if CoSN is notified and credited.

Introduction

At the advent of the 21st century, American schools are devoting more and more financial and staff resources to the task of incorporating technology into the classroom.

This revolution in learning is occurring for many reasons. Increasingly, parents are demanding that their children have access to the latest technology and school officials and politicians are responding.[1] Governments at all levels are making more funds available to support technological improvements. The E-rate program, created by the Telecommunications Act of 1996, has provided an infusion of funds to help schools and libraries get wired and connected to the Internet. And there is growing evidence that if technology is incorporated wisely, it can improve the learning experience.

But when a school district purchases computers or installs a network, the cost of the hardware is only one small part of the expenses it can expect in subsequent years if it is going to use those technological resources effectively.

In this, a district s technology budget is no different from its transportation budget. When a school district buys a new bus, the expense doesn t stop with the cost of the vehicle. There is gasoline to keep it running, maintenance to keep it well tuned, repair bills when it breaks down, increases in insurance premiums and the salary of an additional driver expenses that all must be covered year after year.

If school districts don t do this kind of planning for their technology budgets, there may not be enough money available to provide teachers with adequate training, to maintain new computers or to replace them when they become obsolete. Districts may fail to budget for increases in power consumption or necessary improvements in their physical plant. They may connect their computers to the Internet, but forget about the additional telecommunications costs associated with making that connection. As a result, America s investment in educational technology could fall short of its expected return or even produce a backlash against spending additional dollars on new technology.

As a major Silicon Valley newspaper noted in late 1998: The question asked in the mid-'90s, amid the optimistic din created by high tech, was, How do we get more computers in our classrooms? Swiftly, that question has given way to one more difficult How can we afford to keep them? [2]

The goal of Taking TCO to the Classroom is to provide school administrators and technology directors with tools so that they can better estimate the total cost involved when they build a network of computers and wire their classrooms to the Internet a concept known in the business world as Total Cost of Ownership. Ownership in this context includes all of the costs associated with using and maintaining networked computers, no matter whether a school district owns or leases them. TCO traditionally also includes calculations of costs that may not turn up in a budget, but that can still have an impact on school district operations for example, when computers sit idle because they need to be repaired or when teachers can t use them because there is no money available to train staff members.

Taking TCO to the Classroom is an ongoing project because there has been very little hard data collected on the long-term costs associated with operating and maintaining technology in schools. Many of the projections cited in this report were developed in the mid-1990s, as policy makers began to lay the groundwork for a major push to wire the nation s classrooms. Now, as more and more school districts have installed computers, built networks and connected classrooms to the Internet, more real world numbers are becoming available. Further, alternatives to traditional networks of computers are now being proposed for school settings.

Increasingly, school and government leaders are awakening to the need to monitor and manage these costs. For instance, in 1996, North Carolina, in its Long-Range State Technology Plan, advised schools to consider Total Cost of Ownership, which it defined as acquisition, annual maintenance and upgrade fees, along with five other factors when they selected software and hardware.[3] More recently, in January 2001, the California Department of Education released a state technology planning guide that said, Technology planning needs to be comprehensive and include consideration of the long-term implications of the choices made. . . . Hardware purchased should meet district needs and have the lowest cost of ownership over the long term. [4]

It is hoped that this document will promote a process of better defining those costs, and ultimately, creating guidelines to help school administrators determine whether they have provided adequate funding for all of their expenses so that they can truly understand the total cost of their technology decisions. By better understanding the problem, administrators will be in a better position to evaluate proposed solutions.

In detailing these costs, we do not want to deter school administrators from making an investment in technology. Rather, we want to help them plan for that investment, so that they do not bite off more than they can chew. This will help ensure that when school districts integrate new technology, they don t do it for technology s sake or simply because it is this year s fad, but rather to make long-term improvements in the educational experience and ensure that more real learning can occur in the classroom.[5]

A Quick Checklist for Technology Budgeting

After a district has purchased computers and installed a networking infrastructure, here are the major expenses and technology decisions for which school administrators must be prepared. These issues are covered in depth in this white paper.

✓**Retrofitting:** When your district is ready to build a network, has it budgeted adequately to upgrade electrical capacity, improve heating, cooling and ventilation systems, beef up security systems and remove asbestos and lead found in older buildings? These costs can be reduced if a school district plans for future networking requirements when school buildings are constructed or renovated. In certain cases, wireless solutions may offer potential cost savings.

✓**Professional Development:** Has your district budgeted an adequate amount for staff training, including the cost of trainers, materials and substitutes if training is conducted during school hours? Training costs should represent a large component of a district s technology budget. If staff members are not properly trained, teachers will not understand how to integrate technology into the curriculum, support staff will not keep up to speed on hardware and software developments and the district will fail to achieve the maximum return on its technology investment.

✓**Software:** Has your district budgeted adequately for network management software, computer-based curriculum materials, applications and productivity software and the software needed to adapt technology to the special needs of users? A wide variety of software applications will give school districts greater flexibility, but will also increase the costs for support and staff development. Software licenses also need to be managed efficiently to save money and protect a district from penalties for license violations.

✓**Support:** Has your district budgeted adequately to maintain its network and other hardware and to help others solve their software and hardware problems? The way in which a district deploys a network, and the variety of software and operating systems that it chooses to support, will determine the kind of support that it will need. Some new approaches have been designed to address the particular challenges that school districts can face when they try to provide their own tech support.

✓**Replacement Costs:** Has your school district budgeted adequately to cover the costs of replacing computers and other peripherals? The life cycle of even the most advanced multimedia computer is still only about five years. Businesses now generally plan on a three-year life cycle for desktop computers.

✓**Connectivity:** Has your district budgeted adequately to cover the costs involved with connecting schools to each other and to the Internet? Lower-bandwidth connections will generally cost less but will involve a tradeoff in the complexity of the information that can be shared and the amount of time it will take to download files or access information.

What Is Your School District's Total Cost of Ownership Type?

(Copyright 2001, Consortium for School Networking)

	The TCO-Savvy District	The Doing the Best We Can District	The Worry About it Tomorrow District
Professional Development	Devotes 15-30% of its budget to staff development	Provides some staff training, but not at times that are convenient or when staff is ready to put the lessons to work	Assumes that teachers and staff "will learn on the job"
Support	Provides computer support at a ratio of at least one support person for every 50 to 70 computers or one person for every 500 computers in a closely managed networked environment	Relies on a patchwork of teachers, students and overworked district staff to maintain network and fix problems. Does not track the amount of time its network is down or computers are not in use	Relies on the "hey Joe" sort of informal support
Software	Recognizes that the greater diversity of software packages and operating systems, the more the support that will be required. Makes provisions for regular upgrading of software packages	Utilizes centralized software purchasing, but choice of application and respective support left to individual schools and/or staff members	Expects support personnel to manage whatever software happens to be installed on a district computer
Replacement Costs	Budgets to replace computers on a regular schedule, usually every five years, whether leased or purchased	Plans to replace computers when they no longer can be repaired	Assumes that when computers are purchased with 20-year bonds that they will last forever
Retrofitting	Recognizes that many school buildings will require modifications of electrical, heating and cooling systems, as well as asbestos removal, to accommodate new technology, and budgets accordingly. When possible, makes these improvements when schools are being built or renovated.	Understands minimum and recommended requirements for electrical and other infrastructure improvements and incorporates them when funding is available	Pulls the wires and then blows the fuses
Connectivity	Plans its network to provide connections that provide enough bandwidth to manage current--and future--needs, especially multimedia applications	Has the bandwidth it needs today, but has no plan for scaling it upward as demand grows	A phone and a modem, what more do you need?

Estimating the Total Cost of Technology

For a number of years, the business world has developed several models for calculating what s known as the Total Cost of Ownership (TCO) all of the expenses associated with deploying, maintaining and troubleshooting a personal computer in the workplace. Businesses use these calculations to make strategic decisions on how to build their networks and control their costs.

Consultants have determined that TCO can vary from industry to industry, reflecting how computers are used and how a company designs its network. TCO calculations can also vary based on the formula used to compute it. Some TCO models cast a wide net and try to quantify all of the soft costs associated with a computer, including how much time employees waste playing with their computers or trying to troubleshoot their own hardware or software problems.[6]

The business world bears some resemblance to the administrative side of a school district, where networked computers, if used effectively, can increase productivity and achieve efficiencies. Traditional business models for TCO, however, may be less useful in the classroom setting, where computers are not used in the same way as they are in an office setting or customer service center.

For instance, in 1997 International Data Corp. surveyed 400 school officials and calculated that the Total Cost of Ownership for a school with 75 computers was $2,251 per year per computer, while a comparably sized small business had a TCO of $4,517 per computer, or more than twice that amount. IDC said this difference resulted from four factors: schools purchase less expensive computers at larger discounts than businesses do, educational software packages are priced lower than business software applications, schools generally use roughly half the number of people that businesses do to support the same number of computers, and schools typically use their computers for five years (or more), compared to three years for businesses.[7]

Most school districts and analysts cost projections have tended to focus on the out-of-pocket costs associated with building and maintaining a network. Traditional business Total Cost of Ownership calculations, however, usually go beyond that to produce a more complete picture. For instance, one school district might calculate that it spends less per computer than another district because it spends less on support staff. The first district may have either created an efficient network that can be managed centrally with fewer staff members, or it may not be providing adequate staff to trouble-shoot the problems of its computer users. Unless the school district calculates how much time is wasted when networks are down or computers don t work, it won t understand what its true costs are.

As one TCO expert writes, Organizations, regardless of size or nature can use client satisfaction, service levels and business risk as performance measures. In the end, optimizing [Information Technology] requires looking beyond bottom-line costs and taking into account people, process, finance and technology. [8]

Thus the cost of technology is not the same thing as the Total Cost of Ownership. However, before school districts can calculate their TCO, they must first understand all of the out-of-pocket costs associated with operating and maintaining a computer network.

It is likely that traditional TCO analysis will first gain a foothold on the administrative side of a school district, where computer use more closely parallels the experience of the business world, and where productivity enhancements may be more easily identifiable. However, some kind of TCO analysis can prove just as useful in instructional settings.

As time goes on, school administrators can be expected to learn more about calculating the additional costs associated with Total Cost of Ownership, such as the loss of productivity or wasted investment when computers aren t repaired on a timely basis, when staff members are required to trouble-shoot their own computer problems or when computers sit idle because teachers haven t been taught how to integrate technology into their lesson plans. When administrators reach that stage, they will be much better equipped to make decisions about managing their networks and planning their budgets.

The Big Picture

Although the Total Cost of Ownership for a school district may be less than that of a business, the cost is still substantial. Many school districts recognize that their initial investment will be a large one, and support it with bonds, federal or state grant money or corporate donations. What is harder to prepare for are the long-term costs of operating and maintaining that investment in computers and networking.

How much will it cost? The answer, of course, will vary from district to district, based on differences of size, geography, age of physical plant, patterns of staffing and school management, teaching styles and, naturally, what kind of technology is deployed and how extensively. School districts vary widely in terms of the role technology plays in the district, both on the administrative and instructional side.

What follows is a summary of some of the best available guidance on the overall cost of wiring a school district, as well as individual budget components. The experience of a typical school district may be quite different, as it is likely to encounter funding constraints along the way, and different schools within the district may be at different stages of development. As part of its ongoing work, CoSN s TCO project continues to explore ways that schools could collect and share useful data about the costs of operating their networks.

Districts that have already made a substantial investment in wiring their classrooms now typically spend between 2 and 4 percent of their overall budget on technology; but many planners argue that even more should be spent.[9] A 1998 study conducted for the Milken Exchange on Education Technology found that among 1,990 districts in 27 states, 5.6 percent of their capital budgets, on average, was spent on technology and 3.4 percent of their operating budgets.[10]

A number of studies have attempted to project the cost of wiring the nation s schools on a per-student basis, usually to come up with the estimated cost across the nation or a state. Each makes slightly different assumptions, and includes different items in its budget categories. Most of the analyses are now several years old, and since then some costs have been reduced and newer technologies, such as wireless delivery, have matured.

The details of the studies are provided, when available, in Appendix A. While school districts must be careful in applying a nationwide average projection to their own situation, the studies should provide some guidance about the magnitude of the costs they can expect.

In a frequently cited 1995 study, McKinsey & Company, Inc. calculated the cost per student of implementing several scenarios. Among the models and their projected costs:

The Classroom Model, in which every classroom is connected with networked computers at a ratio of five students per computer, with a T-1 connection permitting long-distance transmission of data, video and voice: one-time costs of $965 per student and ongoing costs of $275 per student per year over 10 years.

The Partial Classroom Model, in which only half of each school s classrooms are wired: one-time costs of $610 per student and ongoing costs of $155 per student per year over five years.

The Lab Model, which assumes each school is connected through a computer lab of networked computers with 10 analog telephone lines per school: one-time costs of $225 per student and ongoing costs of $80 per student per year over five years.[11]

Lower costs per student do not necessarily suggest efficiencies that will be achieved but rather networks with fewer capabilities. The McKinsey numbers, now more than six years old, may also be somewhat out-of-date in light of recent improvements in the efficiencies that can be achieved by making an investment in a centrally managed network and lower telecommunications costs.

In 1998, another consulting group, Integrated Technology Group, LLC, developed a spreadsheet for the National Center for Supercomputing Applications to help school districts estimate the total costs of improving their technology infrastructure. While the estimate varies depending on the circumstances of each individual school or district, it projects that the total cost of a technology program will run above $500 per student per year for the first five years, once all the necessary technology system components, including infrastructure and facilities improvements, staff training, support, personnel, subscription services and curriculum development, are taken into account. This estimate also includes spending for distance learning hardware, telecommunications systems and services, computer upgrades and replacement, inflation and factors reflecting the type and location of the school.[12]

In a 1997 study that looked specifically at the state of New Jersey, the cost was pegged at $417 per student per year, over a five-year period. That figure, however, did not include the cost of retrofitting or expenditures for such items as computer furniture and lighting modifications, which together would be expected to raise the cost to between $475 and $550 per student.[13] In California, the Department of Education prepared a four-year technology plan in 1996 with a projected total cost of $1,987 per student over four years, or $496 per year.[14]

A 1996 MIT study projected that the per-pupil costs of connecting schools to the information superhighway would range from $212 to $501, depending on the complexity of the network, with ongoing costs of $40 to $105 per pupil per year. The upper figure was the projection for a network in which every school would have a local area network and a 56 Kbps connection to the district network, and the district, a T-1 connection to the Internet. A more expensive model was also detailed.[15]

In a 1995 RAND study of the technology implementation costs experienced by eight pioneering school districts, the expense ranged from $142 per student to $490 per student per year. In this analysis, the cost of cabling and special furniture was amortized over 10 years, instead of the five years used by many of the models.[16]

Several studies have projected the cost of building local area networks and wiring classrooms to the Internet to be roughly about $500 per student per year. However, many factors, including the age of the school district s physical plant and its technology investment to date, will determine the precise figure.

Currently, most U.S. schools are spending much less than these models. Quality Education Data projected that in the 2000-01 school year, districts would spend, on average, $113.11 per student on instructional technology. More specifically, QED projected that $44.17 per student would be spent on computer hardware, $26.61 on networks, $10.08 on software, $10.38 for service/support, $4.70 for peripherals, $14.16 on Internet services, $4.60 for professional development, $4.21 for supplies (such as disks, paper and toner) and $2.56 for computer training. According to QED s analysis, professional development represented 4 percent of the total and service/support represented 9 percent. (QED noted its total figure does not equal the sum of the categories, because it was calculated separately for greater precision.)[17]

An informal 1998 survey of 29 school districts in the Council of the Great City Schools, which represents the nation s largest urban school districts, found that their technology budgets provided, on average, about $124 per student, a figure that was close to QED s nationwide projection for that year. The districts spending ranged from $584 per student to $22 per student.[18]

The MIT study projected that for simpler networking connectivity models, the ongoing annual costs would typically be one-half to one-third of the start-up costs. For more complex models, the ongoing costs would be one-fifth to one-fifteenth of the start-up costs. Over the range of available projections described above, ongoing costs were approximately one-fifth of the start-up costs. The Gartner Group, by comparison, advised its business clients in mid-2000 that their ongoing costs could be expected to be about 60 percent of the cost of their installation.[19]

Another way to think about projecting the Total Cost of Ownership is to think about how the total pie for technology is sliced and how the price of those budgeted items will change over time.

In most models, the purchase and installation of hardware and retrofitting old buildings represents the bulk of the costs initially and when amortized over five years. In most of the projections, these kinds of expenses represent between 40 and 60 percent of the costs, depending on the assumptions and how costs are categorized. (See Appendix A for details.)

Over time, however, the bulk of the costs are expected to shift to the kinds of expenses that cannot be covered by the capital budget, namely personnel to provide computer and network support and training to teach the staff how to use the technology and to help teachers integrate it into the curriculum. Hardware costs, however, will remain a significant line item, as computers and other peripherals will need to be replaced on a regular basis.

In the first years of deployment, the largest share of the technology budget is normally devoted to hardware in the form of networks and new computers. As time passes, a greater proportion of the budget should shift to staff development and support.

The real-world experience of school districts, however, often doesn t match what is considered to be the ideal. After surveying the experience of 100 school- and district-level officials, IDC reported in its Total Cost of Ownership study that schools were spending 55 percent of their total costs on hardware, and 16 percent on networking, with 9 percent of the budget spent on software, and only 6 percent on training and 6 percent on service and support. Another 5 percent was spent on supplies and 1 percent on online services.[20]

In the RAND study of the group of early-adopter schools, over a five-year period the average school spent about 46 percent of its technology budget on hardware, 10 percent on staff development, 27.5 percent on support personnel and about 4 percent on materials. The study s authors concluded that when the number of school computers is relatively modest (such as one to every seven to 11 students), the costs for support staff, staff development, materials and supplies will tend to dominate the budget. But when districts push to achieve a lower number of students for each computer, the costs for hardware, software and infrastructure will represent a larger share of the overall costs.[21]

As more and more computers are installed in the nation s schools, educational leaders and policy makers are recognizing that schools must devote more attention to staff development if they are to achieve their technology goals. A number of grant programs have tried to address this problem, and many states are now requiring schools to devote a higher proportion of state-provided dollars to staff development. In addition, many government and non-profit grant programs now require school districts to devote a certain portion of their technology budget, or a portion of their grant budget, to assessment, to review what they have actually accomplished with technology.

In most models of technology implementation, the initial deployment costs are proportionately larger because they include such one-time purchases as networking hardware, wiring, retrofitting a school s physical plant and consulting studies. Once school officials get through that stage, they may think they ve covered most of their expenses. The truth is, the costs are just beginning.

Getting Down to Specifics

Much has been written about the initial costs of hardware and the standards schools should follow when they deploy computers and networks.[22] What is more difficult to plan for are other elements of the budget expenses such as staff development, retrofitting buildings, and replacing obsolescent computers. Here are some more specific guidelines, based on a variety of cost studies, and the experience of some school districts over time.

Retrofitting

One cost that will vary widely from school district to school district is the amount that must be spent to wire an existing physical plant. Retrofitting is not traditionally part of Total Cost of Ownership analyses, but it is a cost that school districts frequently face and sometimes fail to anticipate.

The best time to wire a school is when it is under construction, or in the case of an existing building, when it is being renovated or expanded. Wiring existing schools will involve additional costs, including, in some cases, the cost of asbestos and/or lead removal, new lighting and modifications to meet the requirements of the Americans with Disabilities Act.

For the purpose of producing a nationwide figure, the McKinsey study estimated that 65 percent of American schools were more than 35 years old and had not undergone a major renovation to support technology. The study projected that some of these schools would use wireless technology, but that would not be practical in every case. To wire older schools, the consultants projected it would cost an average of $65,000 per school for asbestos removal and other infrastructure improvements. New schools were assumed to have adequate wiring; schools that were between 5 and 35 years old were assumed to require wiring, but not asbestos removal.[23]

The costs of wiring an older school building can be substantial and often unanticipated. However, the costs can be trimmed if this work is performed when a building is constructed or renovated.

McKinsey also projected that 23 percent of the nation s schools would require an upgrade of their electrical system and another 4 percent, improvements to their heating, ventilation and air conditioning (HVAC) systems. It estimated that the average school would spend $240,000 on electrical upgrades and $31,800 on HVAC. It also projected that the average school district would spend $355 per computer on new furniture and $350 per room on security improvements.

A study for the Council of Educational Facility Planners International and based on 30 construction projects in the Midwest found it cost $1,500 per classroom equivalent for infrastructure in new construction and $3,000 per classroom equivalent in renovation-modernization projects. That cost included one additional 20-amp 100VAC circuit, six empty data box drops and six duplex outlets. Additional electrical service, it said, would cost a minimum of $50,000.[24]

It has been projected that up to 10 percent of the total cost of technology systems and related building modifications could be saved if both initiatives are planned and implemented at the same time.[25]

The real-world experience of school districts can, of course, be very different. Large urban school districts trying to wire buildings that date from the 19th century can face monumental challenges in improving their electrical capacity and pulling wires through walls. For instance, it cost the School District of Philadelphia $1 million to wire a single large high school building at the end of the 20th century. [26]

Districts may find that they can avoid some of the costs of retrofitting older buildings if they are able to take advantage of wireless solutions. Wireless approaches can also easily extend networks to portable classrooms, or to buildings that will be wired in the future. In addition, some districts prefer the flexibility that some wireless solutions can offer in deploying computers and connectivity right to a classroom when it needs them.

Currently, the bandwidth capabilities of wireless solutions are less than those of the best wired solutions, so school districts will need to carefully evaluate how they intend to use a network and whether a particular solution is technologically feasible and will meet their bandwidth needs. Nevertheless, many school districts are moving in this direction to help manage their costs and increase the flexibility of their networks.

Professional Development

The budget item that arguably is most critical to a school district s ability to achieve its technology goals is staff development. If teachers and other staff members do not understand how to use new technologies and incorporate them into the classroom, a district s technological investment will not achieve its desired results.[27]

To underscore this point, the U.S. Department of Education recommended in 1996 that school districts set aside 30 percent of their technology budgets for staff training and development. As the department noted at the time, If there is a single overarching lesson that can be culled from research about teacher professional development and technology, it is that it takes more time and effort than many anticipate. [28] In September 2000, the National Center for Education Statistics reported the results of a survey that indicated that teachers who receive at least 32 hours of training in technology integration over a three-year period said they felt prepared to use technology in the classroom. Unfortunately, only 12 percent of those surveyed said they had received that much.[29]

Today many state departments of education require that districts devote between 20 and 30 percent of their state technology grant money to staff development as a way of promoting that component of the technology budget.[30] And corporate grant programs and government funding sources are also targeting this area for greater attention.

In a 1995 school technology guide, the Massachusetts Software Council noted that many businesses match every dollar they spend on computer hardware or software with another dollar for training. While it acknowledged that that figure was probably too ambitious for most school districts, it recommended that at least one-fourth of a school s technology budget be set aside for that purpose.[31]

Currently, however, schools are spending much less than that. In the 2000-01 school year, Quality Education Data projected that the average district would spend only about 4 percent of its technology budget on staff training.[32]

One of the largest components of the cost of staff development can be substitute teachers, when it is determined that the teaching staff needs to be trained during their regular work hours. The

McKinsey model assumed that a district planning to network all of its classrooms would have to hire substitute teachers at a cost of $100 a day, as well as the equivalent of 1.5 full-time staff members to conduct training, and cover the cost of training materials.[33]

The NCSA/ITEG model, meanwhile, called for a minimum of five days of training per year per teacher and two days per year per administrator, as well as an additional six days per year of informal peer-to-peer training. The model adopted 30 percent of the budget for staff training as the goal to which districts should aspire, but considers 15 percent to be the minimum acceptable.[34]

The 1996 RAND study of eight schools found that the cost of staff development ranged from $15 to $35 per student per year, with most schools spending about $25. As a share of their technology budgets, the percentages ranged from 5.5 percent to 22 percent, with the average among them pegged at about 10 percent.[35]

The U.S. Department of Education and many state departments of education now recommend that districts designate 20 to 30 percent of their technology budgets for staff development. The reality, however, is that most school districts spend much less.

Smart Valley, a mid-1990 s initiative by Silicon Valley companies to network schools and other community institutions in that area, approached the issue another way. It recommended in a school networking guide that an average starting point should be to allocate approximately $1,500 per year for each person requiring training.[36]

In its four-year technology plan, the California Department of Education assumed that the typical school with 700 students and 33 staff members would spend $2,000 per staff member for staff support, materials and mileage and $35 an hour for trainers (with a projected 2,000 hours required per school).[37]

Inadequate staff training will lead to under-utilization of computers and a loss of return on a school district s investment in technology. The Milken Exchange survey of technology directors found that on average, 5.9 percent of their district s computers were not being used. The second most important reason why, cited by 50 percent of overall respondents, was that teachers are not trained to use them. [38]

It s important to remember that despite these budgetary benchmarks, staff training is not a one size fits all sort of proposition. Individual teachers and staff members can vary widely in their previous experience with technology and their readiness to learn. So-called early adopters may not need much training, but they may also not be the best people to serve as trainers. Some staff members are likely to be more enthusiastic than others about incorporating technology, and many of them may be able to serve as mentors to those who still prefer to teach the old fashioned way. Those who are less positive about working with technology will likely need more one-on-one support.[39]

New tools are available to help school districts define and measure the technological capabilities of their staffs. For instance, the California Technology Assistance Project (CTAP) has created a Technology Assessment Profile tool called CTAP^2 to help teachers and student teachers measure their own proficiency level and locate resources to improve their kills. ISTE, the International Society for Technology in Education, has developed standards, called NETS•T, to better define what skills teachers need to use new technologies and integrate them into the classroom. Another approach, called TAGLIT (for Taking a Good Look at Instructional Technology), is designed to help schools assess the readiness of their leaders, teachers and students. CoSN is also part of a group effort, called the Collaborative for Technology Standards for School Administrators (TSSA) that is working to develop skill standards for school administrators. [40]

The issue, however, may not be teachers individual technological capabilities, but rather their ability to integrate new technologies into the classroom experience, particularly when not all students can access a computer at the same time. According to a survey released by NetDay in May 2001, roughly nine out of 10 teachers say they feel comfortable using computers and the Internet, but two-thirds believe that the Internet is not well integrated into their classroom. Two-thirds view the Internet as a good resource, but not a fundamental change to the way they teach.[41]

Finally, a school district must not forget to provide adequate staff development for its own technology staff. If those staff members are not encouraged to increase their own knowledge about new and evolving technologies, the school district will not be able to make the best possible decisions when it comes to planning for and purchasing new technology. Districts that devote adequate resources to staff development should also see a corresponding drop in the cost of providing tech support because staff members will be in a better position to address their own problems without having to seek help from others.

Software

In business settings, the cost of software can sometimes equal the cost of hardware, and generally runs about one-fourth to one-fifth of total hardware costs. In the school environment, however, it is proportionately much less, usually representing 10 percent or less of the total budget.[42] Among the schools in the RAND study, software costs ranged from 4 to 10 percent of their technology budgets, and averaged about 8 percent across the schools. None had purchased site licenses for more than five or six tool-based programs (and the average was closer to three). In addition, the authors reported, schools had saved money through economies of scale by building large libraries of CD-ROM and videodisc products.[43]

The McKinsey model calculated that content in the form of software and online subscription fees would represent 14 percent of the total cost of its classroom model and 20 percent of the cost of its less expensive computer lab model. Over time, it said, the share of the pie taken up by content would grow to about 21 percent of the classroom model s annual budget, and 26 percent of the computer lab model.[44]

Many calculations of the costs of networking schools provide only for basic application software, not the costs of software that could be considered more purely instructional or part of the budget for curriculum materials. Note, too, that some of the cost models were developed before schools began developing their own direct connections to the Internet, saving online subscription fees, if not telecommunications costs, and before they began making substantial use of the resources of the World Wide Web, many of which are available for free. However, there may be hidden costs associated with the use of free Web resources, in terms of the amount of time it may take a teacher to identify those resources and organize them for their students to use.

In the 2000-01 school year, QED projected that the average school would spend $10.08 per student on instructional software and $14.16 on Internet services, but that figure, of course, is an average of both technologically advanced schools and those that have not yet made a substantial technological investment.[45] Over the past three years, the software cost has stayed about the same, while the amount spent on Internet services has risen.

Limiting the diversity of software titles that a district uses is one way to help control other parts of the TCO equation, by limiting the number of staff that will be needed to support the applications and the amount of training staff members will need. However, this may entail tradeoffs in terms of meeting users needs for particular kinds of applications or instructional offerings. Many businesses also find that TCO can be controlled if software packages are upgraded at the same time across the company, and if employees are encouraged to use the same version of the software if they work at home. Money can be saved, too, when the installation and upgrading of software can be controlled centrally over the network.

These perceived advantages to centralized management have led school districts to begin to use so-called thin client networks and Application, or Education, Service Providers, which will be discussed in more depth later on. As another way of controlling costs, some district-level instructional technology staffs specify which software packages they will be willing to support, and require school-level personnel to provide their own support if they insist on using a non-standard package.

Tech Support

After computers are installed, a school district will need people to help maintain its network and other hardware, and to help users solve the problems they encounter with their computers and software packages. The number of support staff required will depend on several variables, including the number of workstations and the variety of operating systems and software applications that must be supported.

School districts typically spend less than businesses do to purchase software. Limiting the diversity of the applications supported is one way to help control support costs, but there may be other, negative tradeoffs.

In its TCO comparison between businesses and schools, IDC found that schools have extremely low levels of support, usually one person for every 500 computer users, compared to the 1:50 ratio it found in the business environment.[46] Further, when an educational PC fails, IDC said, it can get taken out of service for several days, while a business computer is usually repaired or replaced within an hour or two. When the Milken Exchange asked district technology directors how long it took to fix a problem when something broke, and gave them the option of responding in hours or days, the average number of hours reported was 5.6 and the average number of days, 3.6.[47]

It s easy to understand why this happens. When a computer breaks down at a business, an office worker generally becomes totally unproductive. When a school network crashes, teachers are expected to go back to teaching the old fashioned way until it is fixed. If a classroom computer malfunctions, students are simply expected to double up on the computers that are still working.

School systems often fall back on technologically savvy teachers or students to help with support. (The Milken Exchange study found that 39.6 percent of the districts surveyed said they frequently used teachers to provide support and 11.5 percent frequently relied on students.[48] An online survey conducted in fall 1999 by CoSN and the National School Boards Association suggested those numbers were even higher.)[49] Unfortunately this can mean that teachers are pulled away from their primary duties. And when support is inadequate, the district will lose some of the value of its investment in technology when hardware is not repaired quickly. More than 29 percent of respondents in the Milken survey said one reason computers were sitting idle in their schools was because they needed to be repaired.

The frustrations that lack of support can create were described by a 1998 congressional General Accounting Office study of how five school districts covered their technology expenses. The report noted: Officials in all five districts reported having fewer staff than needed. Some technology directors and trainers reported performing maintenance or technical support at the expense of their other duties due to a lack of sufficient support staff. Some district officials also noted high stress levels among district technology trainers or maintenance staff trying to serve many school sites. One result of a lack of staff was lengthy equipment downtime when computers and other equipment were not available for use. In several districts, repairs for some equipment reportedly took as long as two weeks or more. Equipment downtime means reduced access for teachers and students, and several officials observed that this may frustrate teachers and discourage them from using the equipment.[50]

Reviewing the available literature reveals a range of recommended levels of support. The state of Maryland, for instance, completed a four-year technology plan in late 1998 with a funding projection that assumed that there would be one support person for every 500 PCs.[51] In another guide to school networking published by the state of Washington, the fully-staffed model assumed that each full-time technician would support between 100 and 250 users.[52] Highly standardized networks can reduce the number of support staff required by a factor of 10, according to some estimates from one staff person for every 50 to 70 computers to one for every 500 to 700.[53]

So how much tech support does a school district need? The answer is, it depends.

The state of Michigan recently tried to create a model to help school districts calculate an appropriate level of tech support for their networks. The project staff began by surveying school districts around the state and was surprised to discover that there was no correlation between the level of tech support and school users satisfaction. Some districts provided relatively good tech support, but users expectations were also high and in their view, the support fell short of what was needed. Conversely, some districts provided sub-standard levels of support, but users apparently had such low expectations that they reported that they were satisfied.

The Michigan project began with a formula for calculating tech support that was developed in the 1980s by a private industry initiative.[54] In July, 2000, the project released a draft worksheet that attempted to adapt the formula to the realities of the K-12 world. As part of the calculation of their needs, schools were supposed to count the number of computers, printers and peripherals they owned and then to calculate a factor based on the number of users. (Although most school-based users are not at the same computer all day, the way computers are used in the business world, each new user will inevitably increase the demands on the tech support staff because of the need to manage such things as passwords, user profiles and e-mail boxes.)

The Michigan formula also takes into consideration the number of software applications that need support, the need for curriculum support and other considerations such as Web site management, telephone system management and whether the school district provides video services.

The project identified a number of special factors that could have a major impact on a district s needs. Tech support needs were expected to increase if:

- the district was large geographically;
- the district had more than 10 buildings;
- the buildings were old and generally badly wired;
- most computers were more than two years old and generally of poor quality;
- the district had to support a wide variety of brands, models and types of computers;
- software installation and network maintenance were not performed centrally; and
- the district relied heavily on distance learning or a technology-based curriculum.[55]

A determination of tech support needs, the project concluded, should be tied to a district s own technology goals. A district that is attempting to be state-of-the-art will likely have greater needs for regular support than will a district where technology is merely an after-thought. As in business, though, managing rising tech support costs will probably be a major challenge for many school technology directors.

School districts typically do not support their computers and networks with the same level of staffing that businesses do. The result is that there is substantially more down time in the educational world. More centralized control of networks with network management software is one way of reducing the number of support staff that will be needed. Reducing the number of operating systems and applications that are supported is another.

In late 1999, CoSN and the National School Boards Association asked members of NSLA s Technology Leadership Network what strategies they were trying to pursue to control the costs of tech support. As more than 90 percent of the districts that responded had all of their schools connected to a Wide Area Network, and 83 percent of them had a Local Area Network in each school, they could be considered among the most technologically advanced of the nation s districts. Larger districts were over-represented in the sample, but responding districts represented a wide range of sizes.

Asked to choose from a list of strategies for controlling tech support costs, about nine out of 10 respondents identified four that they had tried: limiting the ability of teachers and students to modify the way computers are configured, standardizing the model of computer used, shifting to a centrally-controlled district-wide network and relying on teachers and non-tech support staff to provide support.

The latter approach, of course, does not really save any money from a TCO standpoint, it simply transfers the cost to another part of the budget, namely teacher salaries. Depending on how much a school district is relying on informal support from teachers, the tech staff may be able to demonstrate that a school district is devoting the equivalent of several teacher positions to fill this gap.[56]

A critical part of monitoring tech support needs is benchmarking. Fewer than 40 percent of the districts that responded to the CoSN/NSBA survey said that they tried to track the adequacy of their tech support by maintaining records on such things as the amount of time their network was down or the number of computers that needed repairs. Unless school districts attempt to measure the results that their budget for tech support is able to achieve, they will have no way of discerning whether they are doing an adequate job, and whether additional dollars can make a qualitative difference.

Increasingly, however, technology leaders are recognizing the importance of providing adequate support. In its January 2001 education technology planning guide, the state of California said, It is important that school districts plan for adequate technical support for hardware, software, and local and wide area networks. The technology plan should state how teachers obtain technical support, the expected response time, the number of full-time staff needed for technical support, whether students will be involved in providing technical support, and how they will do so. If technical support will be provided in-house, districts are strongly encouraged to establish the maximum number of machines that each technical support person can maintain and ensure that as the amount of technology expands, the level of technical support is maintained according to the pre-determined ratio. [57]

Thin Clients and Application Service Providers

Because of the challenges of providing adequate tech support and managing growing school networks, more districts are taking a closer look at so-called thin client networks and Application Service Providers.

In a thin-client network, very little computing power resides in the desktop device. Most of the applications run on a centralized server. This approach requires a very reliable network and substantial bandwidth but means that less money will have to be spent on desktop computers or appliances. Districts that want to evaluate this approach will want to review what kinds of applications they want or need to run and whether they will be appropriate for this kind of network infrastructure. Software programs that incorporate extensive multimedia features or involve the manipulation of large amounts of administrative data may be more difficult to support. Further, the district will probably have to be prepared to devote more resources to network configuration and management.

In fall 2000, the Broward County, FL, school district launched a pilot project to evaluate the costs and capabilities of thin clients. Eight different vendors participated in the project, and the district plans on sharing its results as it proceeds. [58]

Taking this one step farther is the Application Service Provider. This approach involves putting a third party in charge of a school district s applications and running them on the third-party s servers. This will probably involve tradeoffs in the amount of flexibility a district will be able to enjoy, but should provide savings in the costs of providing tech support and network management.

TCO experts believe this approach is well suited for customers who want more predictable costs when their network grows and in instances when it is hard for a customer to retain qualified tech support people. (Many school districts complain that it is hard to find tech support staff when they can earn higher salaries in private business.) TCO specialists advise, however, that contracts with Application Service Providers should be carefully written to provide protections in case problems occur down the road. School districts will also want to review how their own data will be managed and protected in these kinds of arrangements, and whether those controls are adequate.[59]

Donated Computers

One of the big challenges tech directors face when they try to standardize computers in a school or district is the impact of donated computers. Often, well-meaning local businesses and residents may offer to donate older computers to schools and schools that desperately need technology often agree to accept them.

Experienced technology directors, however, recognize that these computers will often create more headaches than they are worth. While the computers may be free, there are usually substantial costs associated with taking an inventory of them and then upgrading them to the standards of the district s network. Sometimes districts can run into problems when software licenses are not transferred properly. When the computers are extremely old, it will turn out that the business has simply transferred its hardware disposal problem to the over-worked tech staff at the school.

In late 2000, Congress moved to liberalize the deduction a business could enjoy when it donated computers to a school. Most tech directors now advise that it is a good idea to have a policy in place specifying what kind of computer a school district is willing to accept. This can also protect the district technology staff if it turns out that principals are accepting sub-standard computers for their schools and then expecting the tech staff to support them. The school districts of Denver and Hillsborough County, FL, are among those that now post their donations policy on their Web site. The Houston Independent School District, meanwhile, now requires that computer donations be coordinated through its Technology and Information Systems Division. It charges a school $50 to evaluate whether a computer is compliant, and then any costs associated with bringing it into compliance. If it is not cost-effective to upgrade the donated computer, it is sent to the warehouse for auction.[60]

Some districts *have* successfully channeled donated computers into low-income homes that might not otherwise have a computer and occasionally into vocational-technology courses involving computer repair. Occasionally a potential donation could be large enough that it would, in fact, create a new standard for an individual school or small district. Further, thin-client networks may enable a district to manage a mix of older-model computers on the same network.

However, because the variety of operating systems and hardware models will always tend to increase the costs of providing support, school officials should be well aware of the potential negative impact of a donated computer before they agree to accept one.

Replacement Costs

When a school district has just installed dozens of brand-new multimedia computers, it s easy to forget that the day will come when they will need to be replaced. Although wiring, racks and electrical closets are presumed to have a life cycle of about 20 years, that s not the case for computers, servers and peripherals. They are expected to have a life cycle of between three and five years, depending on the equipment and the assumptions of the budget plan.

Thus it makes sense for a school system to purchase new computers on a five-year cycle and to replace them on the same cycle. Sometimes a district will decide to channel older machines to simpler uses, but that can ultimately lead to additional costs in the areas of support and maintenance.

In the Denver school system, for instance, the district assumed that when it purchased a new computer, it would not automatically get rid of it when it was five years old; rather it assumed that 10 percent of the district s computers would be retired each year. However, when it calculated the costs associated with leasing computers, it assumed that all units would be rotated at the end of a five-year lease.[61]

Unfortunately, most school districts budgeting practices do not make it easy to set aside money for future purchases. A school that receives a sum of discretionary money in one year is likely to lose any of the funds it has not expended by the end of the fiscal year, one school budgeting expert noted. As a result, schools are often unable to make a large coordinated purchase of computers and associated equipment at one time. Moreover, they are prevented from saving money to make such a purchase to replace a computer lab once it has become obsolete. [62]

To help meet their tech support needs, tech directors are increasingly negotiating contracts with strong service warranties or lease agreements under which computers will be replaced on a regular schedule to increase standardization. In April 2001, the Hillsborough County (FL) Public Schools drew press attention when the district signed a five-year exclusive agreement, worth more than $50 million, to purchase the district s computers from one manufacturer. The arrangement included additional training for the technology staff and rebates for employees and parents when they purchased computers from the same manufacturer.[63]

School districts should be prepared to replace a computer every five years.

Because many school districts may be unable to predict when they will have the financial resources available to replace a computer, many experts recommend that they should purchase computers with as much processing power and memory as they can afford. That way, the hardware will be better able to handle new or expanded software packages as they become available.

Districts may also find that they will have to pay fees to dispose of computers when they can no longer be used.

Connectivity

The costs of connecting to the Internet are a relatively small proportion of the total costs of educational technology. Although these costs have usually been included in projections of what it would cost to wire the nation s schools, they are not always included in a Total Cost of Ownership calculation because a business s computers may not be connected to the Internet or a Wide Area Network.

In the McKinsey computer lab model, connection costs represented only 8 percent of the budget initially and 15 percent of ongoing costs; in the model when all classrooms were connected, these costs represented 4 percent of the initial deployment costs and 7 percent of the ongoing costs. The study assumed that regular telephone lines would be the primary means of Internet connection in the computer lab model, while T-1 lines would be used in the classroom model.[64]

Since 1997, the percentage of public school classrooms that are connected to the Internet has skyrocketed, from only 27 percent in 1997 to 77 percent in the fall of 2000, according to a May 2001 study by the National Center for Educational Statistics. And those connections aren t just the simple dial-up connections of the past. NCES found that 77 percent of schools had a dedicated connection at a rate of at least 56KB. Twenty-four percent of schools reported that they had an ISDN, wireless or cable connection.[65]

E-rate discounts have enabled school districts to purchase substantially more bandwidth than they otherwise might be able to afford. Although telecommunications costs tend to be higher in rural areas than in urban centers, that factor is reflected at most levels of the E-rate discount matrix. In addition, some states have built statewide educational networks that provide schools with very low-cost or free access to the Internet.

Many technology directors are discovering that whatever bandwidth is made available, a school district will find ways to put it to use. School districts may decide that they can afford to purchase only a certain level of connectivity for instance, a 56 Kbps Internet connection instead of a T-1 line. However, there will be a tradeoff in terms of the speed with which students and staff can communicate, connect to the Internet, and download graphic and video-intensive files. This, in turn, could have an impact on how staff members and students spend their available time.

Districts would be well advised to assume that their future bandwidth needs will increase, and to plan a connectivity solution that can grow as those needs grow.

Budgeting Considerations

This paper has attempted to detail the breadth of expenses that can be expected if technology is to be successfully implemented in a school or school district. Some of the expenses will probably be covered by the district s capital budget, while others will need to be supported on an ongoing basis by the operating budget. School districts frequently get technological improvements kickstarted by a large, and often extraordinary, infusion of funds from a bond measure, a state or federal grant, a donation of corporate dollars or equipment, or even a program such as the E-rate. What is important to remember, however, is that the district must be willing to commit itself to a long-term investment in technology spending, or the computers, networks and other kinds of hardware that are typically purchased with these dollars will simply go to waste.

Although the costs per student of building a technology infrastructure are often expressed on an annualized basis over a five-year period, the cost of purchasing hardware will usually be highest in the first years. Nevertheless, computers and networks will require ongoing maintenance, support, and, in the case of computers and peripherals, regular replacement costs that will continue after the initial installation. In addition, teachers and other staff members will continue to require new training as new pieces of hardware and new software applications are introduced.

Unfortunately, many school districts are forced to rely on strategies such as issuing bonds to purchase hardware that will need to be replaced well before the bonds are repaid. This can make it harder for districts to come up with sources of funds for their ongoing technology operating expenses.

In its 1998 study of five school districts, the GAO wrote: Program components that were hardest to fund, technology directors and others said, were those heavily dependent on staff positions (maintenance, training, and technical support). Staffing was difficult to fund because some funding sources could not be used for staffing and because some sources were not well suited for this purpose. For example, bonds and special levies passed by the districts we reviewed could only be used for capital expenditures. Officials also pointed out difficulties both in using one-time grants for ongoing staff positions and in attracting funding for staff from outside supporters. [66]

Just as many businesses are often tempted over time to cut computer support and training costs to improve their bottom line, school districts often fail to budget adequately for these kinds of expenses when they are trying to balance their budgets. The results, from a Total Cost of Ownership perspective, can be very similar.

After a school district makes a major investment in new hardware through, bonds, grants, special appropriations, or corporate donations it often can be hard to find the dollars to support the ongoing costs of staff development, support and hardware replacement.

Shrinking the IT budget simply shifts the costs down the line and, in large companies, we often find that old-style TCO methodologies pushed 50 percent to 70 percent of IT dollars off the books and straight into business units. This is most often found in vulnerable help desk and training areas. . . , noted one TCO consultant. Cuts in end-user desktop training budgets resulted in an increase in user-induced outages, diminished technology utilization, poor productivity, peer support that disrupted normal operations and covert staff hiring. [67]

Substitute school districts for large companies and schools for business units and the description could easily describe technology budgeting in many districts. Administrators may not have the tools in place to understand and calculate the real financial impact of their budgeting decisions, but the results are the same for the computer user and the overall enterprise.

The Gartner Group has reported that end-user operations, that is, the time wasted on system failures and unproductive user activities, generally represent the largest component of Total Cost of Ownership, at 45 percent. Even when school districts budget adequately for Gartner s other key components capital costs, administration and technical support these end-user costs are usually unbudgeted, but still significant. Gartner argues, in fact, that when support budgets are trimmed too aggressively, every $1 in budgeted savings can actually lead to $4 worth of lost productivity.[68] As schools and teachers are increasingly judged on the basis of the performance of their students, productivity losses should become an even more important factor in school budgeting decisions.

These new challenges may require school administrators to think differently. As one study notes: Market forces drive a company to examine its production costs and the overall efficiency of its operations. . . . Potential new technologies are investigated, cost-benefit analyses are conducted and a system is selected based on its potential to positively impact production, efficiency and (hopefully) market share. The final outcome is a company that remains competitive in the marketplace. In stark contrast, local education agencies typically engage in a less linear, and less logical series of decisions. . . . [Technology] decisions are based on the amount of dollars available, the assumed potential that technologies have for impacting students and the belief that schools need technology in order to fulfill their mission. Note that, unlike the business community, efficiency and productivity do not drive this decision-making process. [69]

The kind of centralized decision-making that generally leads to reductions in the Total Cost of Ownership is not always easy to sell. A case study of reducing the level of client-server support at Intel Corp., for instance, found: To deliver a successful project, Intel s IT department had to convince the rest of the corporation to change its PC buying habits. This was no small task, and one that was approached with a great deal of trepidation. Specifically, IT wanted to take the power of choice away from the users. This was not a popular proposal. Most Intel organizations thought of their power to select their own PC technology as an unquestioned right. Ultimately, the Intel study concluded, the project succeeded in large part because of the support of Intel s president and chief operating officer, Craig Barrett.[70]

Similarly, TCO initiatives in school districts should be supported by the district s top administrators if they are to succeed. And administrators must recognize that there may be a price to pay in the costs of long-term maintenance and support if individual schools are permitted to make their own decisions on how technology will be deployed.

Getting a handle on TCO and technology costs will not be easy not at a time when school technology expenditures are rising rapidly possibly to between 3.2 percent and 8 percent of current educational budgets if the goal of wiring the nation s classrooms is to be achieved. But the magnitude of that spending is sure to bring new scrutiny and new pressures on school budgets.[71]

In a 1995 article, four McKinsey consultants wrote: While the [technology] funding challenge sounds reasonable in aggregate, numerous pressures are squeezing education budgets at national, state and local levels. The Department of Education forecasts that increases in real operating costs and student enrollment will drive annual spending to rise by 2.6 percent each year. In addition, systematic underinvestment in schools physical plant has left the nation with an estimated $101 billion capital deficit. And these demands come at a time when governments are under pressure to do more with less. . . .

All the same, it should be possible to secure adequate funding through a combination of reducing costs, reprogramming existing funds, and launching new initiatives in the public and private sectors. [72]

The ultimate goal of this project is to develop a consensus on how much should reasonably be devoted to these cost components, and to make technology planning and budgeting easier and more effective for school administrators. It took many years for businesses to learn the language of Total Cost of Ownership; now school administrators have the opportunity to build on that experience to suit the requirements of their own environment.

Once administrators understand the true costs associated with introducing technology, they will have new tools with which to plan their budgets for the 21st century. They will be better equipped to protect their district s significant investment in technology. But most important, they will be able to evaluate whether the technology is truly serving their district s educational goals.

Notes on Sources and Additional Resources

Although the authors of this white paper have attempted to keep the links cited below current, with the passage of time that has become increasingly difficult.

The Consortium for School Networking does maintain a long list of additional resources on many of the topics discussed in this white paper. Readers are encouraged to refer to those resources for updated information and Web citations. The list is available at http://www.classroomtco.org/resources.

[1] According to the education marketing company Quality Education Data, U.S. public school districts are expected to spend $5.8 billion on technology in the 2000-01 school year, including funds for hardware, networks, software, service, staff development, computer training, peripherals, Internet access and related supplies. From the 1995-96 school year to 1999-00, the ratio of students to computers improved from 10:1 to 5.1:1. Quality Education Data, Technology Purchasing Forecast, 2000-01, and 2000 QED National Education Database cited by Jeanne Hayes, QED, at the Consortium for School Networking s 2001 Annual Conference. See http://www.qeddata.com for more information.

[2] Slonaker, Larry. Schools Find Hidden Costs of High Tech, San Jose Mercury News, December 21, 1998.

[3] The North Carolina plan is available at http://www.dpi.state.nc.us/Tech.Plan/Long-Range.Tech.Plan.html.

[4] California Department of Education, Education Technology Planning: A Guide for School Districts, released in January 2001, is available at http://www.cde.ca.gov/ctl/techplaninfo.html.

[5] Much has been written about the value of improving the technological capabilities of schools and best practices for technology planning. Those topics are outside the scope of this document. It assumes that a school district has already made or is about to make a substantial investment in computers and networking. In addition, technology plans often incorporate improvements in the school district s telephone infrastructure and videoconferencing and distance learning capabilities. While the same principles of effective budgeting apply to these technologies, their costs are not specifically covered here.

[6] For instance, one model, developed by the Gartner Group in the late 1980s, estimated that every PC running Windows 3.1 in a loosely managed networking environment really cost $11,000. Using slightly different criteria, the International Data Corporation estimated the TCO for the same PC was $5,100. Gartner pegged the total cost of a networked computer running Windows 95 at $9,784. Forrester Research Inc. and Zona Research Inc. have put the

cost at about $2,800. The Gartner approach is described at http://www.microsoft.com/Education/planning/implement/tco/default_sch.asp.

[7] International Data Corporation, Understanding the Total Cost and Value of Integrating Technology in Schools: An IDC White Paper Sponsored by Apple Computer, Inc., 1997. Available at http://www.apple.com/education/k12/leadership/LSWTF/IDC1.html.

[8] Nelson, Gerry, TCO: The Next Generation, MIDRANGE Systems, November 30, 1998.

[9] Washington State Office of the Superintendent of Public Instruction and Northwest Regional Educational Laboratory s Northwest Educational Technology Consortium, A Guide to Networking for K-12 Schools, 1998. Available at http://www.netc.org/network_guide/. McKinsey & Company, Inc., Connecting K-12 Schools to the Information Superhighway, 1995. Available at http://www.uark.edu/mckinsey.

[10] Solmon, Lewis C., Progress of Technology in the Schools: Report on 27 States, 1998 study for the Milken Exchange on Education Technology. Available at http://www.mff.org/edtech/.

[11] McKinsey.

[12] Zeisler, Alfred, Technology Implementation in Schools: Total System Cost and Funding Opportunities, presentation at Grants and Funding for Technology Conference, sponsored by eSchool News Communications Group, November 1998. More information about the Technology and Facilities Modification Investment Worksheet, developed by Integrated Technology Education Group, LLC of Short Hills, NJ, for the National Center for Supercomputing Applications, is available upon request through http://www.ncsa.uiuc.edu/IDT.

[13] Division of the Ratepayer Advocate, State of New Jersey, Before 2000: Funding Technology in New Jersey s Schools and Public Libraries by the End of the Century, 1997. Available at http://www.njin.net/rpa/schools.htm. Al Zeisler of Integrated Technology Education Group and Lee McKnight of Massachusetts Institute of Technology were primarily responsible for preparation of the report.

[14] California Department of Education, Connect, Compute, and Compete: The Report of the California Education Technology Task Force, 1996, with additional calculations. Available at http://www.cde.ca.gov/ftpbranch/retdiv/ccc_task/ccc.htm.

[15] Rothstein, R.I. and McKnight, L., Technology and Cost Models of K-12 Schools on the National Information Infrastructure, 1996. Available at http://rpcp.mit.edu/Pubs/k12costs/CSTB.pdf.

[16] Glennan, Thomas K. and Melmed, Arthur. Fostering the Use of Educational Technology: Elements of a National Strategy, (RAND), 1996 Available at http://www.rand.org/publications/MR/MR682/contents.html. The original survey, The Cost of High Technology Schools, by Brent Keltner and Randy Ross, was discussed in Melmed, Arthur, ed. The Costs and Effectiveness of Educational Technology, November, 1995. Available at http://www.ed.gov/Technology/Plan/RAND/Costs/

[17] QED, Technology Purchasing Forecast, 2000-01.

[18] Council of the Great City Schools, Organizing K-12 Information Technology Resources, unpublished survey, with additional calculations.

[19] Rothstein and McKnight. Gartner Group citation from the company s 3rd Annual TCO Conference, Managing TCO Effectively: Bridging the Gap Between Business and IT, Dallas, Texas, March 15-17, 2000.

[20] IDC.

[21] Melmed.

[22] Many resources are now available online to help school districts develop technology plans and build computer networks. Many manufacturers of networking equipment provide helpful information on their Web sites. Additional background can be found at http://www.classroomtco.org.

[23] McKinsey.

[24] Meeks, Glenn E., Fisher, Ricki and Loveless, Warren, Implementation Costs for Educational Technology Systems, A CEFPI Brief on Educational Facility Issues, December 1997, available at http://www.cefpi.org/issue7.html

[25] Zeisler, Alfred. Determination of Potential Cost Savings that Could Result From a Systems Approach to School Facility Design and Technology Specification, prepared for the schoolwire.org Web site and presented at the Grants and Funding for Technology Conference, cited above.

[26] Westall, Robert, director of networking, School District of Philadelphia, at Taking TCO to the Classroom workshop, Consortium for School Networking s 2001 annual conference, February, 2001.

[27] Staff development was the focus of the CEO Forum s 1999 report Professional Development: A Link to Better Learning. Available at http://www.ceoforum.org.

[28] U.S. Department of Education. Getting America s Students Ready for the 21st Century: Meeting the Technology Literacy Challenge, 1996. Available at .http://www.ed.gov/Technology/Plan/NatTechPlan.

[29] Teacher s Tools for the 21st Century: A Report on Teachers Use of Technology, National Center for Education Statistics, September 2000. Available at http://nces.ed.gov/pubsearch/pubsinfo.asp?pubid=20000102.

[30] Education Week, Technology Counts 98: An Education Week/ Milken Exchange on Education Technology Report on Schools and Reform in the Information Age, 1998. Available at http://www.edweek.org/sreports/tc98/.

[31] Massachusetts Software Council. The Switched-On Classroom s Technology Planning Guide for Public Schools in Massachusetts, 1994. Available at http://www.swcouncil.org/switch2.stm.

[32] QED, Technology Purchasing Forecast, 2000-01.

[33] McKinsey.

[34] ITEG.

[35] Glennan and Melmed, citing Keltner and Ross, with additional calculations.

[36] Smart Valley Inc., Technical Guidebook for Schools, 1995. Available at http://www.svi.org/netday/info/guidebook.

[37] California Department of Education, Connect, Compute and Compete.

[38] Solmon.

[39] Strategies for dealing with teachers differing attitudes toward technology are detailed in educator Len Scrogan s book Tools for Change: Restructuring Technology in Our Schools, published in 1997 by the Institute for Effective Educational Practices.

[40] More information about the CTAP project can be found at http://ctap2.iassessment.org. The ISTE standards can be reviewed at http://cnets.iste.org/teachstandintro.html. The TAGLIT project can be reviewed at http://www.taglit.org and the status of the TSSA standards can be found at http://cnets.iste.org/tssa/index.html.

[41] NetDay survey, The Internet, Technology and Teachers, released in May 2001. Press release available at http://www.netday.org/news_survey.htm.

[42] IDC.

[43] Keltner and Ross.

[44] McKinsey.

[45] QED. Technology Purchasing Forecast, 2000-01.

[46] IDC.

[47] Solmon.

[48] Ibid.

[49] Further details of the CoSN-NSBA survey are available on the CoSN TCO Web site, www.classroomtco.org/checklist/support.htm.

[50] General Accounting Office, School Technology: Five School Districts Experiences in Funding Technology Programs, (Letter Report, 01/29/98, GAO/HEHS-98-35). Available at http://www.gao.gov/archive/1998/he98083t.pdf.

[51] Maryland Business Roundtable for Education Committee on Technology in Education, State of Innovation: The Maryland Plan for Technology in Education, 1999-2003, prepared for the Maryland State Board of Education, December 1998.

[52] Washington State.

[53] Arizona Society of Technology Directors, Technology in Arizona: A K-12 Perspective, 1997. Available at http://www.aztea.org/resources/whitepaper/.

[54] The Project Athena formula is described in the Arizona technology guide cited above.

[55] Details of the Michigan project are available at http://techguide.merit.edu.

[56] The technology staff of the Fairfax County, VA, school district, for instance, demonstrated to school leaders that if every teacher was forced to spend one hour a week troubleshooting his or her own problems, and if tech-savvy teachers were helping their peers at least 1.5 hours a week, that represented the equivalent of 330 FTEs worth $16.5 million in salaries. Although Fairfax is a large district, if the same formulas are applied to a district with only 35 teachers, the district would still be devoting the equivalent of one FTE teacher a year to tech support.

[57] California Department of Education, Education Technology Planning: A Guide for School Districts.

[58] More information about the Broward County project is available at http://www.broward.k12.fl.us/emergingtechnology/thin.

[59] Gartner Group

[60] The Denver school district spells out questions to ask prospective computer donors and its criteria for accepting donations at http://edtech.denver.k12.co.us/tech/order/donations.html. The Hillsborough County policy can be reviewed at http://apps.sdhc.k12.fl.us/sdhc2/technology/standards/Donations.htm. The Houston policy is detailed in a memo available at http://www.houstonisd.org/technology/Donations%20Memo.pdf.

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[61] The Denver school district conducted a TCO analysis as part of five-year tech plan. It can be accessed at http://edtech.denver.k12.co.us:8080/tech_plan/costs/cost.html.

[62] Picus, Lawrence O., The Challenges Facing School Districts in Budgeting for Technology, white paper prepared for Smart Budgets for a Digital Age, 1997, sponsored by Bell South Foundation. Available at http://www.bellsouthfoundation.org//pubs/budget/budget2-1.htm.

[63] A press release describing the agreement is available at http://www.sdhc.k12.fl.us/~public.affairs/pressreleases/2000-2001/signing.htm.

[64] McKinsey.

[65] National Center for Education Statistics, Internet Access in U.S. Public Schools and Classrooms: 1994-2000, May 2001, available at http://nces.ed.gov/pubs2001/2001071.pdf.

[66] GAO.

[67] Nelson.

[68] See Lowering Total Costs in Education, http://www.microsoft.com/education/planning/implement/tco/default_sch.asp.

[69] Tetreault, Donald, Educational Technologies: What Are They and What are the Costs? , white paper prepared for Smart Budgets for a Digital Age, 1997, sponsored by Bell South Foundation. Available at http://www.bellsouthfoundatino.org//pubs/budget/budget3-1.htm.

[70] Henry, John and Harkins, Malcolm, Reducing the Cost of Client/Server Support: A Case Study of Intel Corporation, Revision 2.1, February 20, 1997.

[71] Glennan and Melmed.

[72] Meisel, Ted, Nevens, T. Michael, Singer, Margot and Tate, Karen A, World Class: Schools on the Net, The McKinsey Quarterly, 1995 Number 4, pp. 31-41. Available at http://mckinseyquarterly.com/computer/wocl95.htm.

Appendix A: Details of Cost Projections

McKinsey Projection of the Cost of Connecting Schools to the Information Superhighway, 1995

Model	Initial Costs Per School	Ongoing Costs Per School	Initial Costs Per Student	Ongoing Costs Per Student
Lab	$125,000	$45,000	$225	$80
Lab Plus	$255,000	$85,000	$460	$150
Partial Classroom	$340.000	$90,000	$610	$155
Classroom	$555,000	$165,000	$965	$275

These projections assume 5.7 schools per district, 533 students per school, 31 teachers per school, 21 classrooms per school and 25 students per classroom. The Lab Model assumes each school is connected through a computer lab with 25 networked computers and 10 analog telephone lines. The Lab Plus Model is similar, but assumes that a computer and modem is provided for each teacher. The Partial Classroom Model assumes that only half of each school s classrooms are wired and that a T-1 connection is available for long-distance transmission of data, video and voice. The Classroom Model assumes that every classroom is connected with networked computers at a ratio of five students per computer. Initial deployment costs include the purchase and installation of equipment and first-year operating expenses. Ongoing costs include usage charges, equipment and content upgrades, and professional development and support. Costs of the Lab Plus and Partial Classroom models are amortized over a five-year deployment schedule; the costs of the Classroom model are spread over a 10-year deployment schedule. The model assumes that most schools will use telephone company connections, except for some rural schools where wireless radio connections were assumed.

Cost Components, Computer-Based Infrastructure

	Initial Costs, Lab Model	Ongoing Costs, Lab Model	Initial Costs, Classroom Model	Ongoing Costs, Classroom Model
Hardware	34%	17%	51%	14%
Professional Development	19%	31%	14%	41%
Content	20%	26%	14%	21%
Connection within School	12%	5%	13%	4%
Systems Operation	8%	6%	4%	13%
Connection to School	7%	15%	4%	7%

Hardware includes multimedia computers, printers, scanners, furniture stations and security stations, and necessary building upgrades or retrofitting for some schools. The ongoing hardware costs assume a computer replacement cycle of seven years and a five- to 10-year replacement cycle for the other equipment. The models assumed that each school already has 14 multimedia computers. Professional development costs include substitute teachers and staff support to help teachers integrate technology into the curriculum. Costs of training courses are also included. Content costs include prepackaged software and access and usage charges for online services. The costs for Connections within School include the materials and labor for installing Ethernet LANs as well as file servers, hubs and routers, as well as file servers for the district. The projection assumed that a wireless LAN is deployed in about half of the buildings needing retrofitting. It assumed that 7 percent of classrooms were already connected to a LAN. Systems Operations costs include resources shared across the district dedicated to designing and operating the system. The Connection to School includes installation, access and usage charges for both the schools and the district. Except for some rural schools, wireline connections are assumed (POTS for the Lab models and T-1s for the Classroom and Partial Classroom models).

New Jersey School Study, 1997
Costs Per School Over Five Years

The average cost per student to implement this plan is $417 per year over five years. The figure does not include related physical facility changes. The model assumes that the average New Jersey district has four schools (fewer than the nationwide average) and that the average school has 515 students, 37 teachers and 35 rooms.

Component	Cost	Share of Total
Computer Equipment	$346,125	32%
Distance Learning Equipment	$83,850	8%
In-School Network	$39,220	4%
District Network	$32,132	3%
Internet Connection	$27,810	3%
Telephone System on Premises	$31,200	3%
Training	$137,500	13%
Support	$377,814	34%
TOTAL	$1,075,652	100%

Computer equipment includes computers, printers and other peripherals, software and servers. Distance-learning equipment includes interactive full-motion video systems, as well as video systems and video and distance learning content materials. In-School Network includes local area network wiring and electronics costs. District Network includes networks that link schools within a district, including routers, networking equipment, and telecommunications costs. Internet Connection represents a district-wide network connection to the Internet, including telecommunications costs. Support includes staff for technology systems, repair costs for equipment and supplies for equipment.

California Department of Education
Four-Year Cost to Reach Benchmarks, 1996

These projections are based on the assumption that an average school has 700 students, 33 staff members, 27 classrooms and two other networked rooms. A calculation of the statewide costs is included in the original analysis.

	Assumption for Average School	4-Year Cost, Average Room	4-Year Cost, Average School	Percent of Total
I. Staff Development and Support				**21%**
Trainers	2,000 hours of training @$35/hour	$2,414	$70,000	
Staff support, materials, mileage, etc.	$2,000 per person (33 staff members)	$2,276	$66,000	
District-county technical support	.3 FTE=$15,000 per year for 4 years	$2,069	$60,000	
School site technical support	.5 FTE=$25,000 per year for 4 years	$3,448	$100,000	
4-Year Total		**$10,207**	**$296,000**	
II. Learning Resources				**27%**
Computer software	$2,000 x 29 rooms for 4 years	$8,000	$232,000	
Upgrades	$200 x 29 rooms for 4 years	$800	$23,200	
Other multimedia materials and services	$500 x 29 rooms for 4 years	$2,000	$58,000	
Communications (connect charges, etc.)	$1,265 per school per month x 12 months for 4 years	$ 2,094	$60,720	
4-Year Total		**$12,894**	**$373,920**	
III. Hardware and Telecommunications Infrastructure				**40%**
Computers	6 computers @ $1,525 x 29 rooms	$9,150	$265,350	
Special interfaces	$700 for each of 29 rooms	$700	$20,300	
Scanners	$675 for each of 29 rooms	$675	$19,575	
Networked laser printers	$1,100 for each of 29 rooms	$1,100	$31,900	
Color printers	5 @ $400 each (shared by school)	$69	$2,000	
Audio recorders and players	5 @ $75 each (shared by school)	$15	$375	

Headphones	174 (1 per computer) @ $30	$180	$5,220	
Liquid crystal presentation panels	5 @ $1,100 (shared by school)	$190	$5,500	
Video capture boards	5 @ $350 (shared by school)	$60	$1,750	
Video cameras	5 @ $600 (shared by school)	$103	$3,000	
Videodisc players	5 @ $325 (shared by school)	$56	$1,625	
Television monitors	$500 for each of 28 rooms	$483	$14,000	
VCRs	$350 for each of 28 rooms	$338	$9,800	
Overhead projectors and screens	$500 for each of 28 rooms	$483	$14,000	
Fax machines	2 @ $400 (shared by 29 rooms)	$27	$800	
Telephones	$50 for each of 28 rooms	$48	$1,400	
High-speed copiers	2 @ $5,000	$345	$10,000	
Telecommunications infrastructure	$74,000 per school	$2,552	$74,000	
Furniture and Security Equipment	$2,700 for each of 29 rooms	$2,700	$78,300	
4-Year Total		**$19,272**	**$558,895**	
IV. Maintenance Upgrades and Replacements	**Replacements represent 15 % of installed hardware**	**$5,844**	**$169,475**	**12%**
GRAND TOTAL (4 Years)		**$48,217**	**$1,398,290**	

RAND Corp. Data on Eight Pioneering High-Tech Schools, 1995

	Lowest in Range	Highest in Range	Mean	Median
Annual Cost/Student	$142	$490	$333	$390.5
Number of Students	310	1,800	977	850
Students: Computers	11:1	1.5:1		
Hardware	29.64%	66.75%	46.11%	43.77%
Software	3.88%	10.40%	7.84%	8.61%
Infrastructure	2.19%	7.10%	4.89%	5.21%
Staff Development	5.57%	22.29%	9.85%	7.73%
Support Personnel	3.28%	39.48%	27.4%	31.6%
Materials	1.75%	6.33%	3.83%	3.82%

Costs of hardware and software are amortized over five years. Infrastructure includes special furniture and cabling and is amortized over 10 years. Cost of initial professional development for teachers is amortized over five years. Cost of new staff, staff development, materials and supplies was treated as an annual expense.

MIT (Rothstein and McKnight) Projection for School-Based LANs with Central Connection to the District and to the Internet, 1994

Projection assumes that the average school district has six schools with 518 students, 257 teachers, 25 other staff, and 20 classrooms. Model assumes that each school already has seven computers capable of running graphical Internet applications. Model includes 60 computers per school, a 56Kb network connection to the district office, a T-1 connection to the Internet and 20 dialup connections. This was the second most expensive model of five that were detailed by the study.

ONE-TIME INSTALLATION COSTS	LOW	HIGH
SCHOOL-LEVEL		
Local Area Network	$20,000	$55,000
Personal Computers	$60,000	$120,000
File Server	$4,000	$15,000
Connection to Hub/District Office	$500	$2,000
Router and CSU/DSU	$2,600	$5,000
Retrofitting (major)	$10,000	$25,000
TOTAL	**$97,100**	**$222,000**
DISTRICT-LEVEL		
File Server	$2,000	$15,000
Router	$2,000	$5,000
District LAN	$2,000	$5,000
Data line to WAN/Internet (T-1)	$1,000	$5,000
Dialup Capabilities (20 lines)	$16,000	$32,000
Training (40-50 staff/school)	$50,000	$150,000

ONE-TIME INSTALLATION COSTS	LOW	HIGH
TOTAL	$73,000	$212,000
ANNUAL OPERATING COSTS		
SCHOOL-LEVEL		
Replacement of Equipment	$3,000	$8,250
Connection to Hub/District Office (56Kb)	$1,000	$5,000
TOTAL	$4,000	$13,250
DISTRICT-LEVEL		
Internet Service (T-1)	$10,000	$42,000
Dialup Lines	$3,000	$5,000
Support (2-3 staff/district)	$66,000	$150,000
Training	$15,000	$35,000
TOTAL	$94,000	$232,000
One-Time Costs Per Student	$212.47	$501.14
Annual Costs Per Student	$39.77	$104.69

Breakdown of Model s Costs When Startup Costs Are Amortized Equally Over Five Years, Excluding PC Purchases

Budget Component	%
Hardware	36%
Support	33%
Training	13%
Telecommunications	11%
Retrofitting	7%

Hardware is defined as wiring, routers, and servers, including installation, maintenance and service of hardware and telecommunications lines. Training is defined as training of teachers and other school staff to use the network. Support is defined as technical support of the network. Retrofitting includes modifications to facilities to accommodate the telecommunications infrastructure, including costs for asbestos removal, electrical systems, climate control systems, added security and renovation of buildings to accommodate networks. Wireless and coax-fiber systems were not evaluated because the technologies were considered to be too new at the time of the study. The cost of educational software is not included.

INSTITUTIONALIZATION OF TECHNOLOGY IN SCHOOLS CHECKLIST[1]

Catherine Awsumb Nelson, Jennifer Post, and Bill Bickel
November 2001

This checklist, based on both field experience and relevant literature, provides a conceptual framework to help evaluators assess the extent to which technology is institutionalized in schools. Institutionalization of technology is defined as the extent to which technology is integrated into the culture and classroom practice of a school, rather than being viewed as an add-on program, and the extent to which school personnel take ownership of the technology and its use. The checklist is grounded in the principle that in order for technology to become institutionalized in a school, the school must develop the appropriate human capital to use and manage it effectively in pursuit of the school's core goals. The checklist is organized around three sequential learning curves that school personnel climb as they develop the capacity to use technology effectively: (1) Maintaining the technology infrastructure, (2) Building teacher technology application skills, and (3) Integrating technology into teaching and learning. The three learning curves overlap temporally but are sequential in the sense that progress on one facilitates growth on the next. We anticipate that this checklist will be useful to both school personnel and evaluators conducting needs assessments, program planning, and evaluation of school-based technology programs, especially where the emphasis is on the capacity of the school to use technology in educationally effective ways[2].

(1) MAINTAINING THE TECHNOLOGY INFRASTRUCTURE	
☐ Comfort with routine glitches	School personnel have achieved autonomy in handling common technical problems (e.g., frozen screen, jammed printer) in their own classrooms.
☐ Dissemination of technical expertise	Through appropriate training and support materials, all school personnel have acquired basic technical expertise. Technical support is not viewed as "someone else's job." The technical support function avoids overreliance on a few individuals, and thus is less vulnerable to their burn-out.
☐ Specialization of roles	A broad base of school personnel have attained in-depth expertise in particular technical areas, making it clear whom to go to with which questions and lightening the load on each individual.
☐ Flexible time	Schedules are configured so that personnel with responsibility for technical support have the flexibility to respond to problems when they happen without compromising their own instructional responsibilities.
☐ Routinized policies, practices, and responsibilities	Technical support is organized to provide preventative maintenance, not ad hoc solutions to crises.
☐ Strategic use of student expertise	Teachers are comfortable drawing on the technical expertise of their students and may give them formal roles in managing the technology.
☐ Standardized configurations and platforms	Standardized infrastructure within the school allows teachers to work together easily to solve technical problems.

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[1] The term "technology" in this checklist refers to computer hardware, software, and connectivity.

[2] For a fuller treatment of the content of each checkpoint, as well as the overall framework of the learning curves, see the article by the same authors, "Evaluating Educational Technology Implementation: A Two-Part Framework for Assessing the Institutionalization of Technology in Schools and Classrooms," in the *International Handbook of Educational Evaluation* (Kluwer, 2002).

☐ Adequate supply budget	Investments in hardware and software are supported by adequate budgets for the replenishable supplies (e.g., disks, printer cartridges) needed to keep them operating.
☐ Stable funding	Initial technology investment is supported by a realistic, ongoing financial commitment to the training, upgrades, and support time needed to keep the machines functioning.
(2) BUILDING TEACHER TECHNOLOGY APPLICATION SKILLS	
☐ Broad training	Mandates or strong incentives are in place to ensure that all teachers, not just technology enthusiasts, receive appropriate training in the use of computer software/applications.
☐ Quality of training	Training reflects research-based best practices for staff development, is geared to the needs of adult learners, addresses teachers' fears and concerns, and emphasizes the application of technology to core instructional tasks.
☐ Flexibility and appropriateness of training materials	Training addresses the full range of technology experience, comfort, and development needs across the staff as assessed by a formal diagnostic tool.
☐ Follow-up from training	Teachers have the opportunity to receive additional assistance, instruction, or clarification after initial training, particularly in one-on-one settings.
☐ Incentives to apply training	School provides formal and/or informal recognition and rewards to teachers who apply technology training in their professional practice.
☐ Plan for dealing with personnel turnover	New teachers receive training in the specific technology available in the school.
☐ Plan for refresher and update training	Teachers receive ongoing training to reflect updated technology and to reinforce and deepen their skills.
☐ Environment that is safe for experimentation	School culture supports innovation and risk-taking, making teachers comfortable and motivated to deepen their skills through "playing" with technology.
(3) INTEGRATING TECHNOLOGY INTO TEACHING AND LEARNING	
☐ Curriculum-specific training	Training goes beyond skill development to address the specifics of how technology can be applied to the substance of the curriculum.
☐ Mentoring/instructional support	Individualized, classroom-based coaching is used to help teachers make the link between the functionality of new technology and the learning objectives of their curriculum.
☐ Attention to how technology changes classroom dynamics	Teachers have training and experience in how technology can enhance engagement, blur traditional teacher/student role boundaries, and foster more inquiry-based and collaborative work and are not fearful of losing control if they use technology to create nontraditional instructional situations.
☐ Longer instructional periods	Instructional periods are sufficiently long so that the logistics of technology use do not compromise the substance of the lesson and so that technology can be used for authentic and exploratory tasks rather than rote learning.
☐ Teacher-student ratio	The teacher-student ratio for technology-based lessons is sufficiently low to provide adequate technical and classroom management support while engaging students in complex learning tasks.

☐ Instructional accessibility of technology	Hardware, software, and connectivity are physically located where it is convenient for teachers to integrate them into the flow of teaching and learning.
☐ Teacher comfort level with basic skills	Teachers have sufficient hardware and software skills to (a) see opportunities to use the technology as a tool to reach instructional objectives and (b) be willing to use the technology with students without fear of a lesson-derailing glitch.
☐ Student skill levels	Students have sufficient hardware and software skills to avoid instructional time being consumed by technical issues rather than the content of the lesson.
☐ Planning time to develop lessons	Teachers have adequate planning time to rethink lesson design to take advantage of technology's potential to deepen student understanding.
☐ Collaborative planning time/ opportunities to observe and share lessons	Teachers have structured opportunities to collaborate with and learn from peers as they work to integrate technology into their curriculum.
☐ Network of contacts beyond school	School staff have access to peers in other schools and/or outside experts to help them develop curriculum integration.
☐ Access to concrete lesson ideas	Strategies and structures exist to facilitate the sharing of relevant, high quality model lessons that can be applied to the school's specific curriculum.
☐ Link to curriculum standards	Training and materials model how technology can be used to reach curriculum standards, making the push for technology and the push for standards complementary rather than competing mandates on teachers.
☐ Content-rich applications aligned with curriculum	In addition to content-free productivity software (word processors, spreadsheets, etc.) that can be adapted to instructional tasks, schools invest in technology with built-in content directly linked to their curriculum.
☐ Student and parent demand	Students and parents are computer literate and aware of the value of technology and encourage teachers to utilize it.
☐ Student technology use standards and evaluation criteria	School has explicit expectations for student technology use woven into curriculum standards.
☐ Alignment of teacher evaluation system with goals for technology integration	Goals and incentives for substantive, curriculum-linked technology use are built into teacher evaluation criteria.
☐ Administrative priorities	Administrators demonstrate commitment to technology integration through the allocations given to technology in schedules and budgets, leadership through modeling technology use, and the creation of incentive systems that reward instructional technology use.
☐ Cooperation between district-level technology and curriculum staff	Messages, activities, and incentives regarding technology and curriculum are coordinated at the district level to reinforce that technology is a tool for learning, not an end in itself.

Total Cost of Ownership
References and Resources

Day , C. William. "The Total Cost of Ownership" *American School and University* Feb. 1 2000. http://industryclick.com/magazinearticle.asp?magazineid=134&releaseid=3728&magazinearticleid=33004&siteid=17

Levinson ,Eliot and Dr. Jim Surratt. " Buying Technology Using Good Horse Sense" *Converge*, June 2000. http://www.convergemag.com/magazine/index.phtml?issue=6:2000

Moskowitz, Steven. "Tackling TCO in K-12 Education" *Learning and Leading with Technology* May 2001 v28 no. 8 p 22.

Smith, Burck. "Consider Total Cost of Ownership When Purchasing Technology"_*Technology Leadership News* June 1999 Vol. 3/No. 4
http://www.nsba.org/itte/tlnews/friend20.html#totalcostofwonership

Taking TCO to the Classroom Consortium for School Networking
http://www.cosn.org/tco/

How to Make the Buy vs. Lease Decision
http://www.nsba.org/itte/tlnews/friend21.html
By Burck Smith, a Washington, DC-based consultant and freelance writer specializes in education and technology. http://www.nsba.org/itte/tlnews/friend21.html

The Technology Support Index from ISTE provides an online assessment that school districts can use to appraise the quality of their technology support program and learn about possible improvements they can employ.
http://tsi.iste.org/

The TCO Calculator can help estimate the multiyear costs of implementing and maintaining technology systems in a K-12 school.
http://www.iaete.org/tco/

Technology Briefs for No Child Left Behind Planners from NEIR*TEC provide NCLB planners with effective strategies, key questions to consider, and selected resources that will inform the application and planning process.
http://www.neirtec.org/products/techbriefs/default.asp

TechSETS identifies a comprehensive matrix of skills needed to support technology services in California schools.
http://www.techsets.org/training/matrix.php?PHPSESSID=b5e987d9dfbf2e7e906674e77359b720

The Michigan Technology Staffing Guidelines has a worksheet and formula for identifying technology staffing needs
http://techguide.merit.edu/

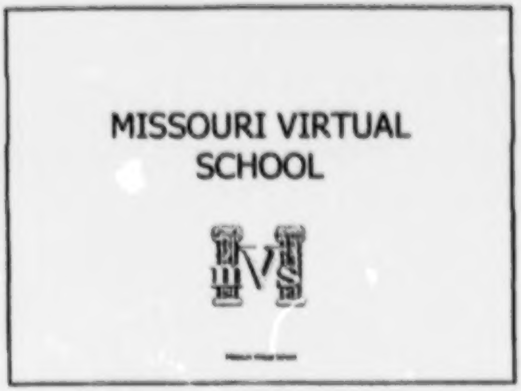
Microsoft Licensing: How does it work?
http://news.com.com/2100-1001-908779.html

Technology Support Solutions for the Rural School: An Analysis of Options.[DRAFT] Hawkes, Halverson, & Brockmueller (2002, in press), Journal of Research in Rural Education.
http://www.homepages.dsu.edu/hawkesm/research_papers.htm

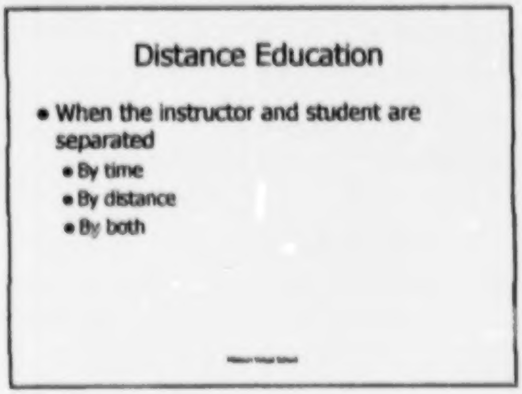
Broward County project to test thin-client technology
http://www.broward.k12.fl.us/emergingtechnology/thin/thinhome.html

Distance Education Update

Jim Tice, Southwest Missouri State University
Tuesday, July 30, 2002

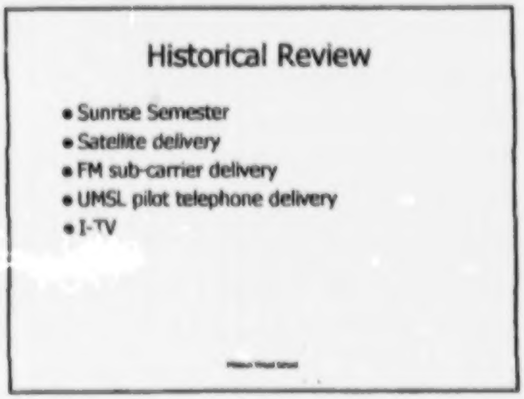


MISSOURI VIRTUAL SCHOOL



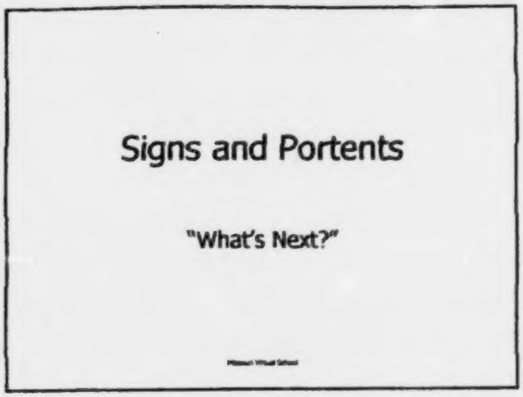
Distance Education

- When the instructor and student are separated
  - By time
  - By distance
  - By both



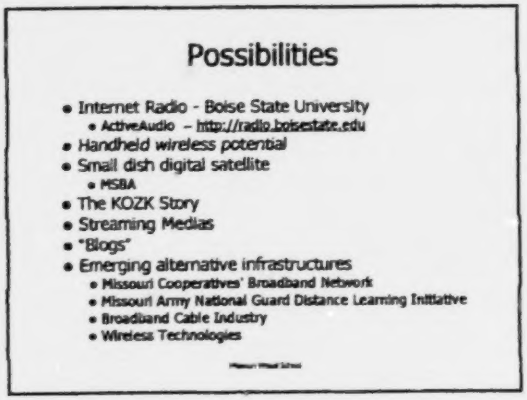
Historical Review

- Sunrise Semester
- Satellite delivery
- FM sub-carrier delivery
- UMSL pilot telephone delivery
- I-TV



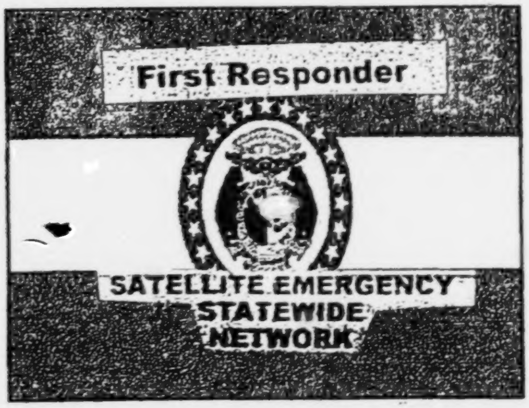
Signs and Portents

"What's Next?"



Possibilities

- Internet Radio - Boise State University
  - ActiveAudio – http://radio.boisestate.edu
- *Handheld wireless potential*
- Small dish digital satellite
  - MSBA
- The KOZK Story
- Streaming Medias
- "Blogs"
- Emerging alternative infrastructures
  - Missouri Cooperatives' Broadband Network
  - Missouri Army National Guard Distance Learning Initiative
  - Broadband Cable Industry
  - Wireless Technologies



First Responder

SATELLITE EMERGENCY
STATEWIDE
NETWORK

Contact:

Keith Crumley
Coordinator, Jefferson City TCRC
6900 Boundary Road
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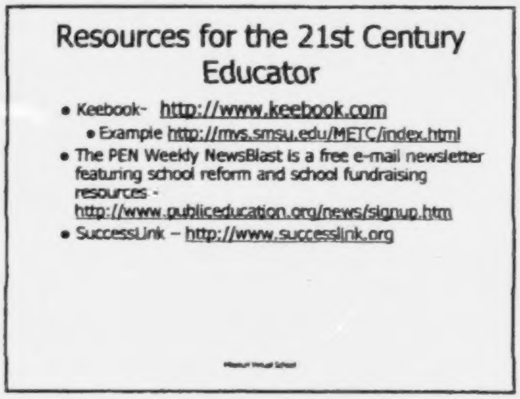
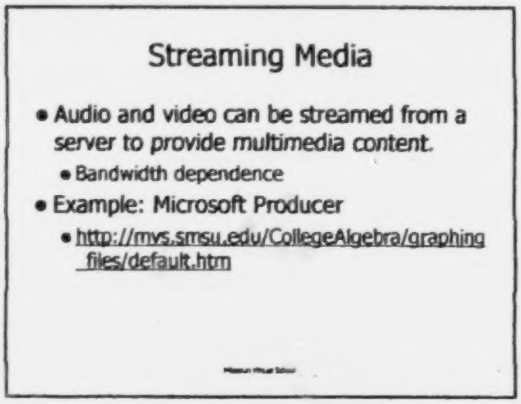
Jefferson City, MO 65101
573 638 9439
Keith.Crumley@mo.ngb.army.mil



Resources for the 21st Century Educator

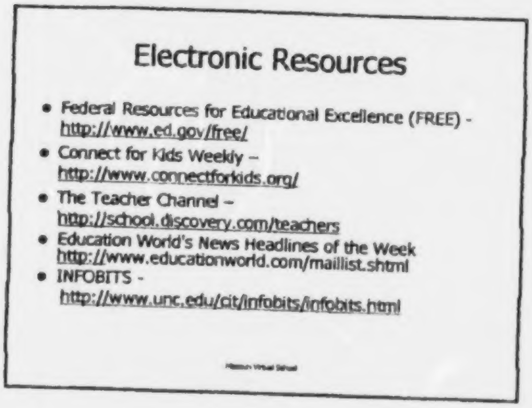
- Keebook- http://www.keebook.com
  - Example http://mvs.smsu.edu/METC/index.html
- The PEN Weekly NewsBlast is a free e-mail newsletter featuring school reform and school fundraising resources - http://www.publiceducation.org/news/signup.htm
- SuccessLink – http://www.successlink.org



Streaming Media

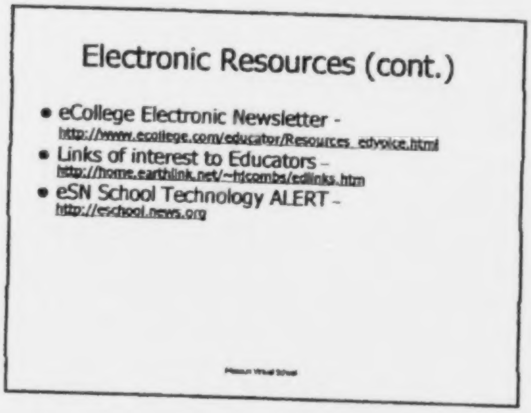
- Audio and video can be streamed from a server to provide multimedia content.
  - Bandwidth dependence
- Example: Microsoft Producer
  - http://mvs.smsu.edu/CollegeAlgebra/graphing_files/default.htm

BEST COPY AVAILABLE



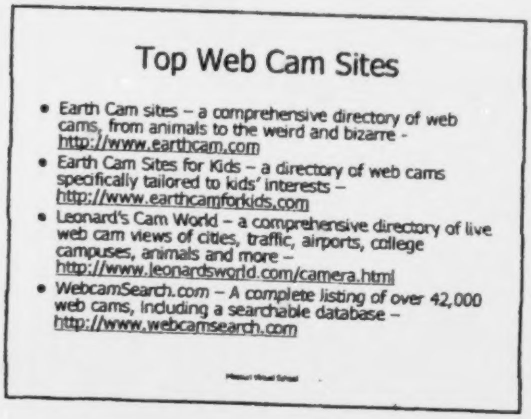
Electronic Resources

- Federal Resources for Educational Excellence (FREE) - http://www.ed.gov/free/
- Connect for Kids Weekly – http://www.connectforkids.org/
- The Teacher Channel – http://school.discovery.com/teachers
- Education World's News Headlines of the Week http://www.educationworld.com/maillist.shtml
- INFOBITS - http://www.unc.edu/cit/infobits/infobits.html



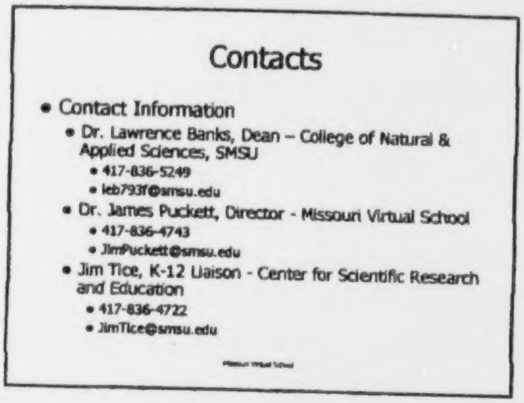
Electronic Resources (cont.)

- eCollege Electronic Newsletter - http://www.ecollege.com/educator/Resources_edvoice.html
- Links of interest to Educators – http://home.earthlink.net/~hcombs/edlinks.htm
- eSN School Technology ALERT – http://eschool.news.org



Top Web Cam Sites

- Earth Cam sites – a comprehensive directory of web cams, from animals to the weird and bizarre - http://www.earthcam.com
- Earth Cam Sites for Kids – a directory of web cams specifically tailored to kids' interests – http://www.earthcamforkids.com
- Leonard's Cam World – a comprehensive directory of live web cam views of cities, traffic, airports, college campuses, animals and more – http://www.leonardsworld.com/camera.html
- WebcamSearch.com – A complete listing of over 42,000 web cams, including a searchable database – http://www.webcamsearch.com



Contacts

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    - leb793f@smsu.edu
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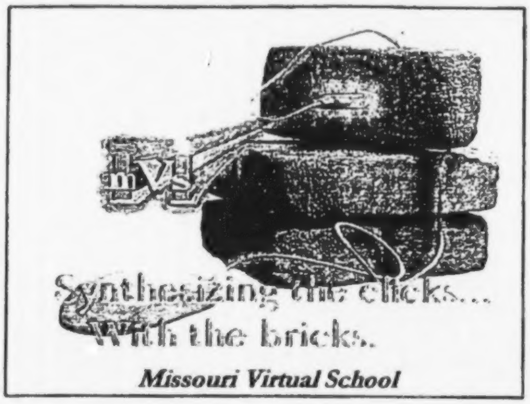
    - JimPuckett@smsu.edu
  - Jim Tice, K-12 Liaison - Center for Scientific Research and Education
    - 417-836-4722
    - JimTice@smsu.edu



Synthesizing the clicks...
With the bricks.

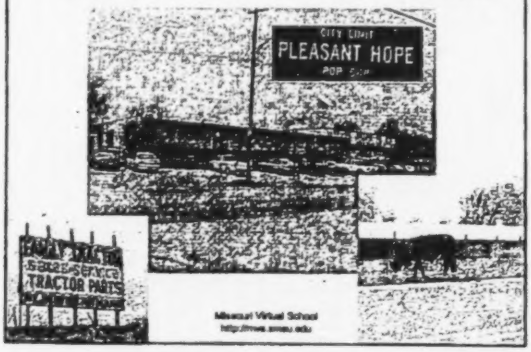
Missouri Virtual School

Mission Statement

The mission of the Missouri Virtual School is to support the educational efforts of Missouri public schools through the use of proximity-based distance education in the delivery of high school curricula.

Missouri Virtual School
http://mvs.smsu.edu

Outreach to Rural School Districts


CITY LIMIT
PLEASANT HOPE
POP
SALES-SERVICE
TRACTOR PARTS

Missouri Virtual School
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Missouri Virtual School Service Area

Missouri Virtual School
http://mvs.smsu.edu

1998-1999

A Physics course taught over ITV to eight students at Strafford High School served as the pilot course for what would become the Missouri Virtual School.

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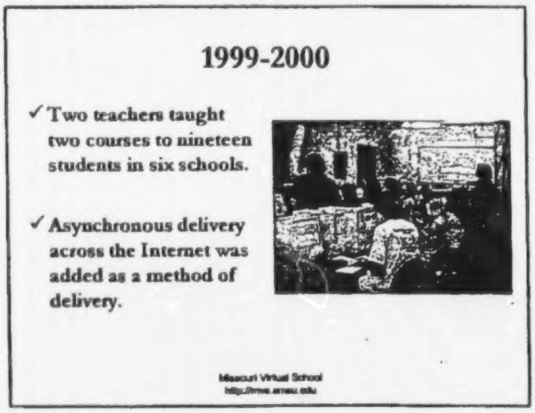

1999-2000

- ✓ Two teachers taught two courses to nineteen students in six schools.
- ✓ Asynchronous delivery across the Internet was added as a method of delivery.

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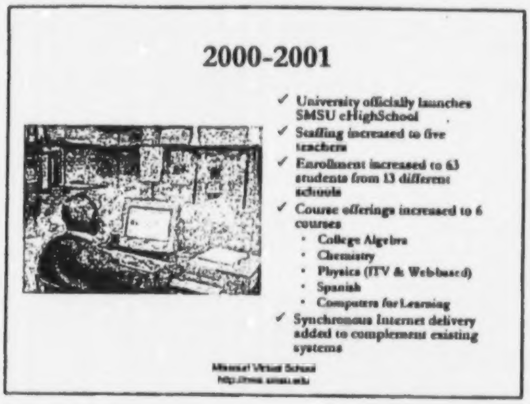

2000-2001

- ✓ University officially launches SMSU eHighSchool
- ✓ Staffing increased to five teachers
- ✓ Enrollment increased to 63 students from 13 different schools
- ✓ Course offerings increased to 6 courses
  - College Algebra
  - Chemistry
  - Physics (ITV & Web-based)
  - Spanish
  - Computers for Learning
- ✓ Synchronous Internet delivery added to complement existing systems

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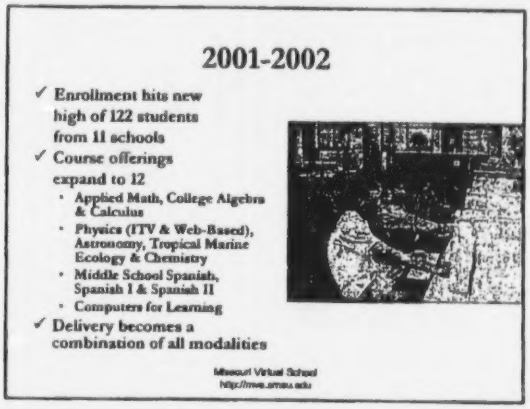

2001-2002

- ✓ Enrollment hits new high of 122 students from 11 schools
- ✓ Course offerings expand to 12
  - Applied Math, College Algebra & Calculus
  - Physics (ITV & Web-Based), Astronomy, Tropical Marine Ecology & Chemistry
  - Middle School Spanish, Spanish I & Spanish II
  - Computers for Learning
- ✓ Delivery becomes a combination of all modalities

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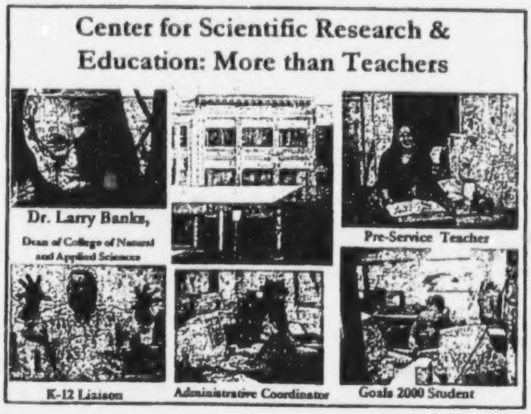
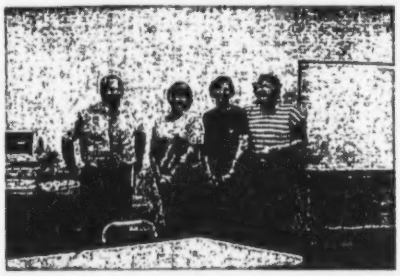


Center for Scientific Research & Education: More than Teachers

Dr. Larry Banks,
Dean of College of Natural and Applied Sciences
Pre-Service Teacher
K-12 Liaison
Administrative Coordinator
Goals 2000 Student

Team of Master Teachers



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Typical Missouri Virtual School Course

- ✓ Has an on-site pre-check of school facilities and staff;
- ✓ Is delivered asynchronously, synchronously or combined;
- ✓ Uses a password protected CMS for assignments, scheduling, email, discussion, etc,;
- ✓ Is taught by a Missouri-Certified Teacher;

Missouri Virtual School
http://mvs.smsu.edu

Typical Missouri Virtual School Course

- ✓ Is placed in the student's master schedule – year long;
- ✓ Has MVS teachers and staff visit during the course for laboratory activities;
- ✓ Has future teachers involved in curriculum design and delivery;
- ✓ Can be offered for dual-credit, AP credit, etc.;
- ✓ Has an on-site facilitator for asynchronous courses.

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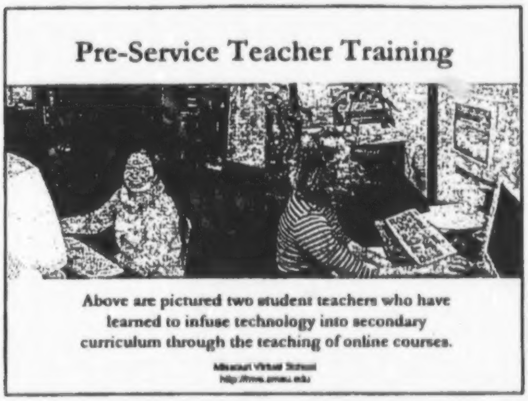

Pre-Service Teacher Training

Above are pictured two student teachers who have learned to infuse technology into secondary curriculum through the teaching of online courses.

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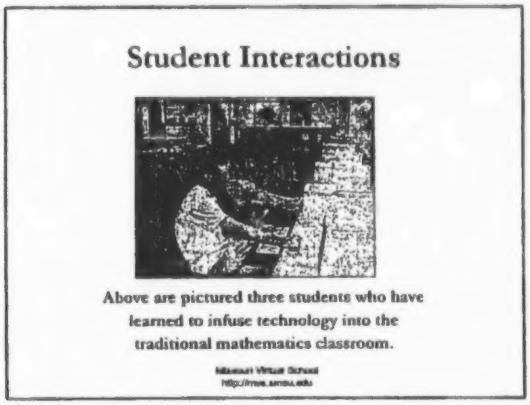

Student Interactions

Above are pictured three students who have learned to infuse technology into the traditional mathematics classroom.

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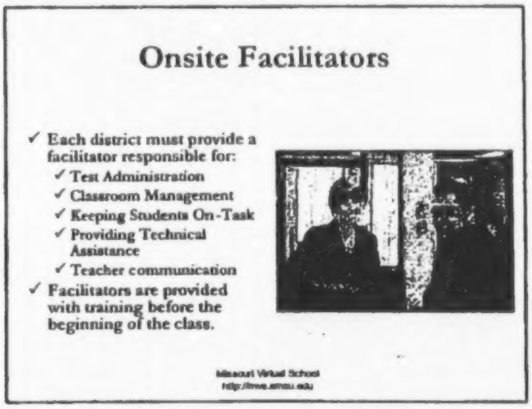

Onsite Facilitators

- ✓ Each district must provide a facilitator responsible for:
  - ✓ Test Administration
  - ✓ Classroom Management
  - ✓ Keeping Students On-Task
  - ✓ Providing Technical Assistance
  - ✓ Teacher communication
- ✓ Facilitators are provided with training before the beginning of the class.

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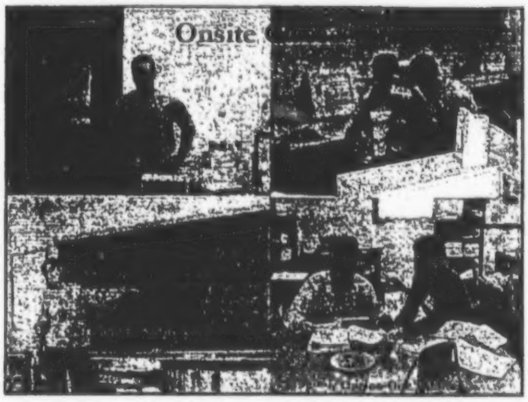
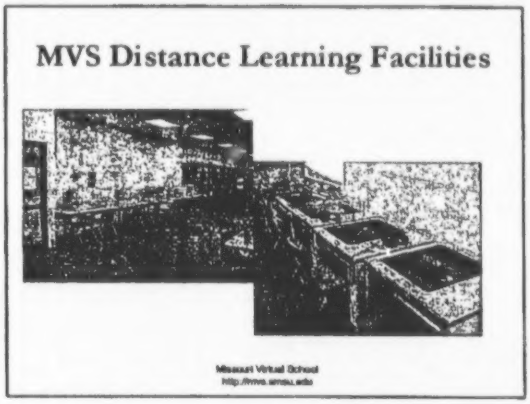


Onsite



MVS Distance Learning Facilities

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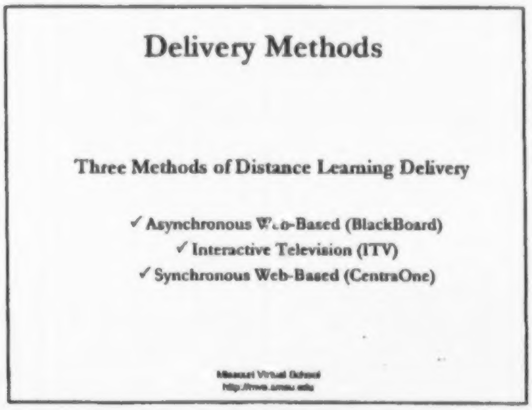

Delivery Methods

Three Methods of Distance Learning Delivery

- ✓ Asynchronous Web-Based (BlackBoard)
- ✓ Interactive Television (ITV)
- ✓ Synchronous Web-Based (CentraOne)

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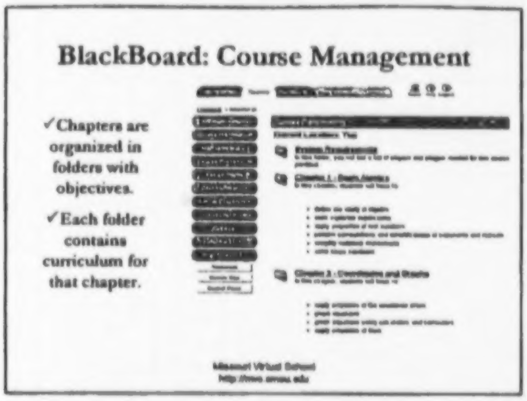
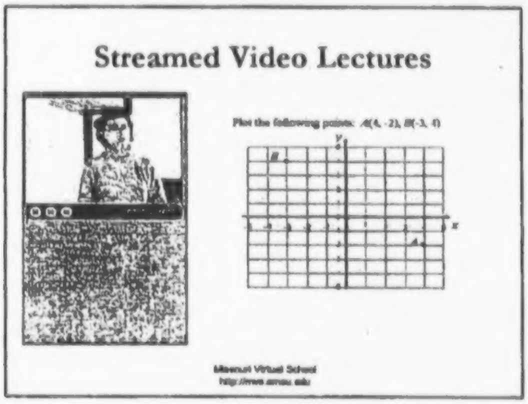


BlackBoard: Course Management

✓Chapters are organized in folders with objectives.

✓Each folder contains curriculum for that chapter.

Missouri Virtual School
http://mvs.smsu.edu



Streamed Video Lectures

Plot the following points: $A(4, -2)$, $B(-3, 4)$

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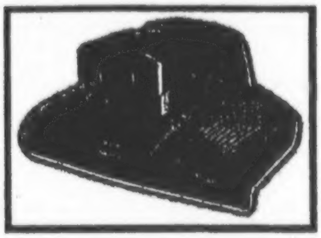
Interactive Television

The Polycom



Missouri Virtual School
http://mvs.smsu.edu

Video Conferencing Resources

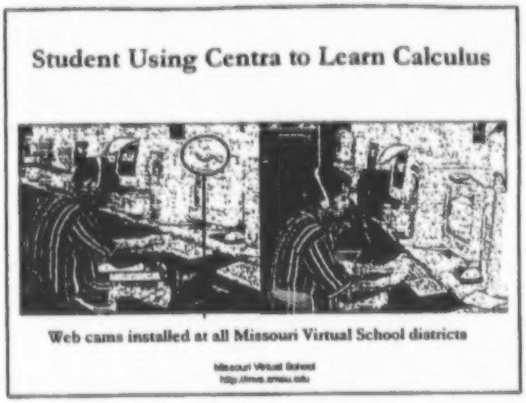
http://www.kn.pacbell.com/wired/vidconf/adventures.html

Videoconferencing Adventures

Missouri Virtual School
http://mvs.smsu.edu

- ✓ Centra has provided Missouri Virtual School with a web-based tool that is easily utilized by a diverse population of school districts and organizations.
- ✓ Asynchronous learning is enhanced through real-time Centra sessions allowing students more individual contact with the instructor.
- ✓ Additional technologies can be integrated with Centra to further the benefit of using this program.

Missouri Virtual School
http://mvs.smsu.edu



Student Using Centra to Learn Calculus

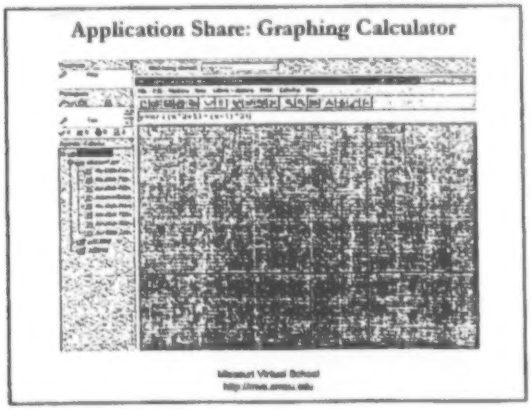
Web cams installed at all Missouri Virtual School districts

Missouri Virtual School
http://mvs.smsu.edu

CentraOne Software

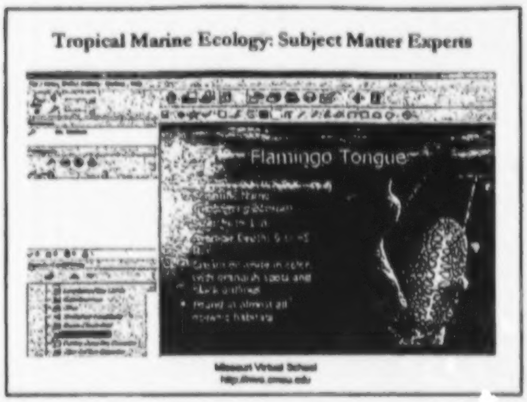
- ✓ Synchronous Instruction
  - Two-Way Full Duplex Audio
  - One-Way Video Transmission
- ✓ Real-time PowerPoint Delivery
- ✓ Shared Whiteboard
- ✓ Application Host & Share
- ✓ Web Safari
- ✓ Breakout Rooms
- ✓ Surveys and Evaluations

Missouri Virtual School
http://mvs.smsu.edu



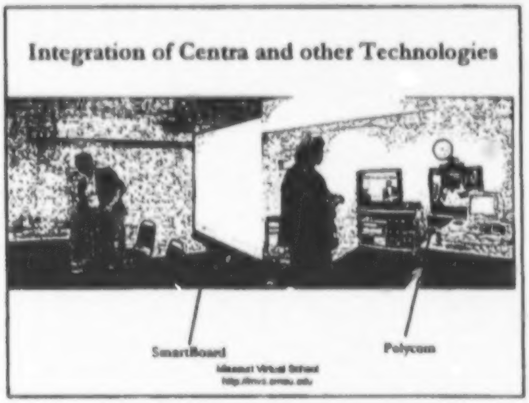
Application Share: Graphing Calculator

Missouri Virtual School
http://mvs.smsu.edu



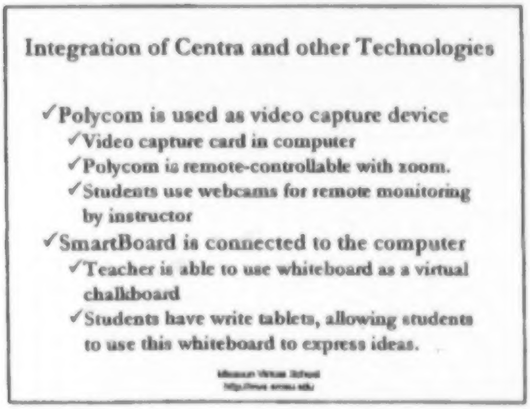
Tropical Marine Ecology: Subject Matter Experts

Missouri Virtual School
http://mvs.smsu.edu



Integration of Centra and other Technologies

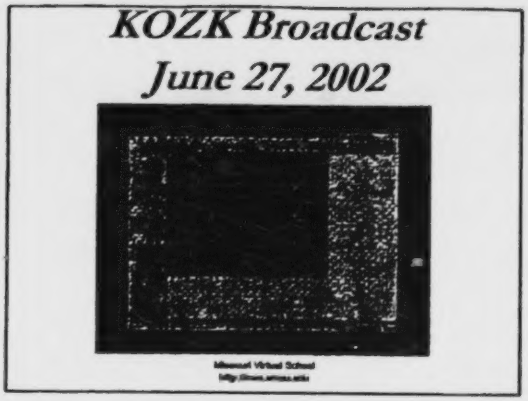
Missouri Virtual School
http://mvs.smsu.edu



Integration of Centra and other Technologies

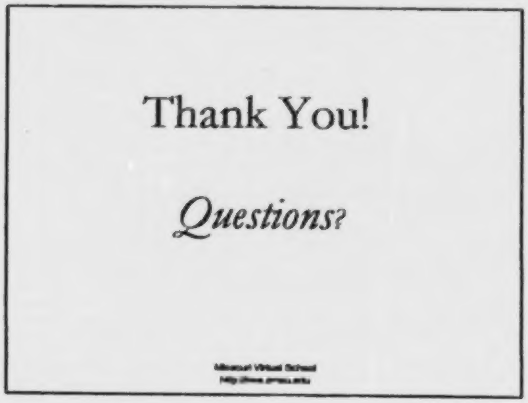
- ✓Polycom is used as video capture device
  - ✓Video capture card in computer
  - ✓Polycom is remote-controllable with zoom.
  - ✓Students use webcams for remote monitoring by instructor
- ✓SmartBoard is connected to the computer
  - ✓Teacher is able to use whiteboard as a virtual chalkboard
  - ✓Students have write tablets, allowing students to use this whiteboard to express ideas.

Missouri Virtual School
http://mvs.smsu.edu



KOZK Broadcast
June 27, 2002

Missouri Virtual School
[illegible]



Thank You!

Questions?

Missouri Virtual School
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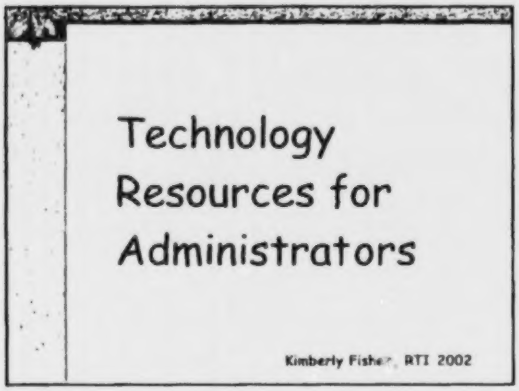
Notes

3

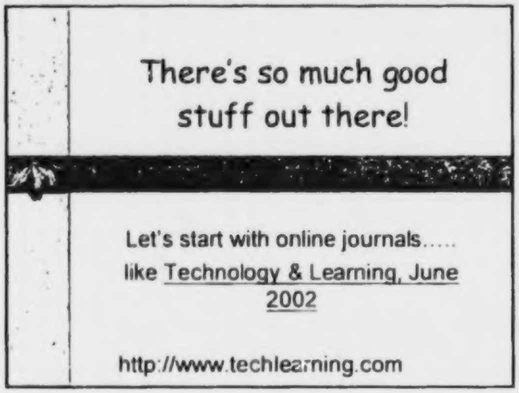
Technology Resources for Administrators

Kimberly Fisher, McREL
Monday, July 29, 2002



Technology Resources for Administrators

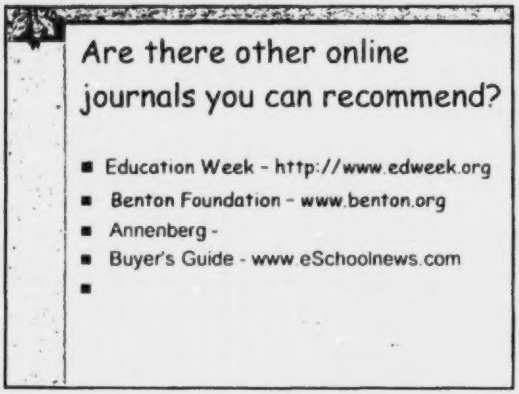
Kimberly Fisher, RTI 2002



There's so much good stuff out there!

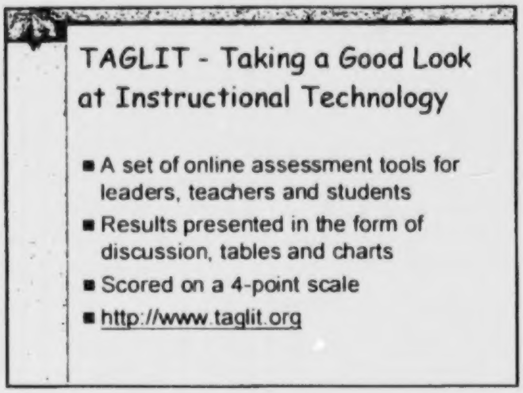
Let's start with online journals.....
like Technology & Learning, June 2002

http://www.techlearning.com



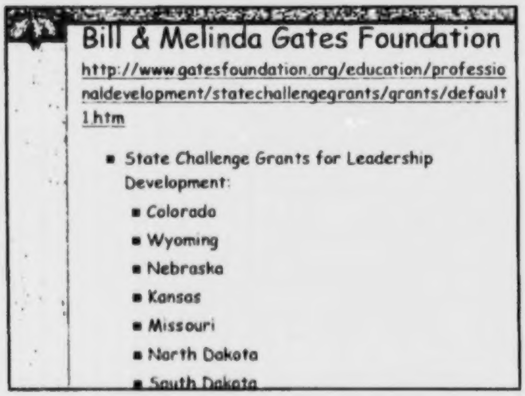
Are there other online journals you can recommend?

- Education Week - http://www.edweek.org
- Benton Foundation - www.benton.org
- Annenberg -
- Buyer's Guide - www.eSchoolnews.com
-



TAGLIT - Taking a Good Look at Instructional Technology

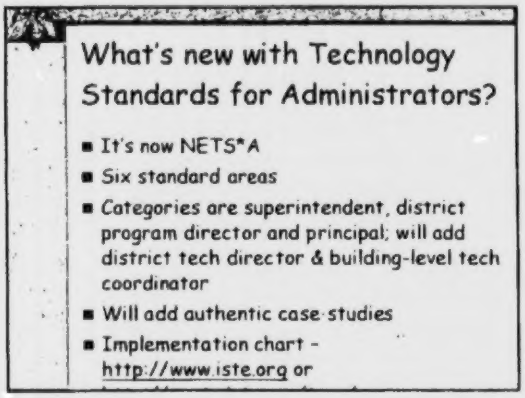
- A set of online assessment tools for leaders, teachers and students
- Results presented in the form of discussion, tables and charts
- Scored on a 4-point scale
- http://www.taglit.org



Bill & Melinda Gates Foundation

http://www.gatesfoundation.org/education/professionaldevelopment/statechallengegrants/grants/default1.htm

- State Challenge Grants for Leadership Development:
  - Colorado
  - Wyoming
  - Nebraska
  - Kansas
  - Missouri
  - North Dakota
  - South Dakota



What's new with Technology Standards for Administrators?

- It's now NETS*A
- Six standard areas
- Categories are superintendent, district program director and principal; will add district tech director & building-level tech coordinator
- Will add authentic case studies
- Implementation chart - http://www.iste.org or

Standard I - Leadership and Vision - *Educational leaders inspire the development of a shared vision for comprehensive integration of technology and foster an environment and culture conducive to the realization of that vision.*

Performance Indicators and Performance Tasks
Educational leaders:
A. facilitate the development of a vision for technology shared by all stakeholders and communicate it widely.

1. Identify key stakeholders for developing and implementing a technology vision.
2. Advocate and promote the relationship between technology and curriculum/instruction.
3. Communicate the vision for technology integration to all stakeholders.

B. develop, implement, and monitor a dynamic, long-range and systematic technology plan that supports the vision.

1. Implement a multi-year plan with an annual review process based on student learning.
2. Organize and develop staff around the implementation of the plan.
3. Implement a comprehensive staff development plan based on the annual review process.
4. Develop a financial plan with appropriate timelines based on the annual review process.
   a) identify potential resources for additional revenues related to technology
   b) reallocate resources to fund the technology plan

C. maintain cohesion and momentum within the school community to reach the shared vision.

1. Make decisions consistent with the technology vision and district mission.
2. Make decisions consistent with the overall vision for technology and school/district improvement plans.
3. Share technology opportunities throughout the school community.

D. model technology use that illustrates the vision for technology in schools.

1. Utilize technologies to disseminate information.
2. Take responsible risks that promote continuous innovation in technology for student learning.

E. advocate for research-based best practices in all uses of technology.

1. Demonstrate the use of research and data to make decisions for implementing and maintaining technology integration.
2. Support technology purchases as evidenced by alignment with the district vision.
3. Analyze and react appropriately to technology issues, concepts, and proposals.
4. Develop a network of resources for technology decision-making.

F. advocate, on the state and national levels, for policies, programs, and funding opportunities that support implementation of the district technology plan.

Standard II - Learning and Teaching - *Educational leaders ensure that curricular design, instructional strategies, and learning environments integrate appropriate technologies to maximize learning and teaching.*

Performance Indicators and Performance Tasks
Educational leaders:

A. identify, use, and evaluate appropriate technologies to enhance and support curriculum and instruction that lead to high levels of student achievement.

1. Use technology to disaggregate and analyze data for decision-making to improve student learning.
2. Promote the development of lesson design to integrate technology that enhances student learning.
3. Plan, develop, and implement a system of gathering data for feedback on teacher/student performance through appropriate technologies.
4. Demonstrate use of technology to evaluate teachers' use of technology.

B. facilitate and support collaborative, technology-enriched learning environments that are conducive to innovation.

1. Develop a structured assessment process for the timely review and updating of technology as it relates to curriculum and instruction.
2. Develop online opportunities that create flexibility in learning.
3. Facilitate the development and implementation of appropriate uses of distance learning and related technologies.

C. provide for the use of technology to meet the diverse needs of all learners in a student-centered learning environment.

1. Plan, budget, and purchase technology resources to be used by all teachers and students
2. Advocate for the use of technology by all students and staff.
3. Utilize a system of data management that facilitates communication within the school community.
4. Use technology to extend learning beyond the classroom walls.

D. facilitate the use of technologies to guide and support instructional methods that promote higher-level thinking, decision-making, and problem-solving skills.

1. Advocate for the use of technology as a tool to enhance learning through a variety of teaching models such as inquiry-based and problem-based learning that promote a student-centered environment.
2. Evaluate classroom and teacher uses of technology based on principles of student-centered and problem-solving models.

E. identify and provide quality professional development opportunities for learning and teaching with technology.

1. Provide teacher training that supports student technology standards.
2. Evaluate educators in the use of technology.
3. Assess the effectiveness of the professional development plan.

Standard III - Productivity and Professional Practice - *Educational leaders apply technology to enhance their professional practice and to increase their own productivity and that of others.*

Performance Indicators and Performance Tasks
Educational leaders:
A. use technology when facilitating change for organizational improvement.

1. Create and support opportunities for others to use technology that improves organizational efficiency.
2. Implement various technologies such as multimedia, hypermedia, and telecommunications to enhance educational opportunities.
3. Use technology to maintain and share an archive of useful research, information, and sources that relate to educational improvement.

B. model the routine, intentional, and effective use of technology.

1. Use productivity tools to enhance professional tasks such as: correspondence, assessment, presentations, problem solving, data collection, information management, communication, and decision-making.
2. Select and implement the appropriate hardware, software and peripherals for administrative tasks.

C. use technology resources to engage in sustained, job-related professional development.

1. Utilize resources such as Educational Service Units, Nebraska Department of Education, Internet, professional organizations, conferences, and journals to remain current in educational technologies.
2. Stretch beyond their personal technology comfort zone continually to create new learnings and support the risk-taking by others in the organization.
3. Initiate and support professional development processes that produce effective uses of technology in teaching and learning.
4. Use technology to remain current on educational issues and practice at the local, regional, state, national, and global levels.

D. employ technology for communication and collaboration among colleagues, staff, parents, students, and the larger community.

1. Access local technology systems to communicate information such as meeting agendas, group tasks, or useful collaborative information.
2. Use technology to enhance school/home/community communications.
3. Use various technologies to create opportunities for collaboration in educational and operational tasks.

E. maintain awareness of emerging technologies and their potential uses in education.

1. Participate in local, state, and regional activities focusing on technology in education.
2. Investigate professional research and best practices related to technology in education.
3. Collaborate with organizations emphasizing technology in education.
4. Support and encourage opportunities for staff and students to participate in activities relating to emerging technologies.

Standard IV - Support, Management, and Operations - *Educational leaders provide direction to integrate technology tools into productive learning and administrative systems.*

Performance Indicators and Performance Tasks
Educational leaders:
A. develop, implement, and monitor policies and guidelines to ensure compatibility of technologies.

1. Maintain a technology specification statement that describes hardware, software, support, and training.
2. Collect and analyze data annually on development and implementation of the technology/school improvement plan.

B. allocate financial and human resources to ensure implementation of the technology plan.

1. Develop job descriptions of technology personnel.
2. Identify and include technology expectations in district job descriptions.
3. Record and review budget information that reflects expenditures used to implement the technology plan.

C. integrate strategic plans, technology plans, school improvement plans, and policies to align efforts and leverage resources.

1. Ensure that the scope and sequence of each curriculum area reflects the integration of strategic and technology plans.
2. Conduct annual evaluation of technology use in classrooms that reflects implementation and integration of the use of technology.

D. design policies and procedures to drive continuous system improvements and to support technology replacement cycles.

1. Review annually the policies and procedures that define the system improvement and technology replacement cycles.
2. Assess the established guidelines for alignment with accepted curriculum standards and best practices.

E. support infrastructure for coordination of district-wide technology programs.

1. Create and communicate a technology organizational chart.
2. Facilitate communication among district stakeholders.
3. Enable collaboration and coordination of policies and guidelines.

Standard V - Assessment and Evaluation - *Educational leaders use technology to facilitate a comprehensive system of effective assessment and evaluation.*

Performance Indicators and Performance Tasks
Educational leaders:
A. assess staff knowledge, skills, and performance in using technology, and use results to facilitate quality professional development and personnel decisions.

1. Utilize technologies as a component of the teacher appraisal system.
2. Collect and use data to guide staff development programs.
3. Assess technology skills in employment decisions.

B. use technology to assess and evaluate managerial and operational systems.

1. Monitor and improve facility operations.
2. Manage budgetary and fiscal processes.
3. Organize and implement student information management systems.

C. use multiple methods to assess and evaluate appropriate uses of technology resources for learning, communication, and productivity.

1. Evaluate current practices in technology implementation.
2. Identify and communicate best practices to support technology implementation.
3. Maintain knowledge of cutting edge hardware, software, and networking systems through vendor contacts, publications, and other sources.
4. Review annually the degree to which the district mission and goals have been accomplished.

D. use technology to collect and analyze data, interpret results, and communicate findings to improve instructional practice and student learning.

1. Utilize technologies to support school improvement efforts.
2. Use data to guide decision-making.
3. Analyze the impact of technology on instructional practice and student learning.

Standard VI - Social, Legal, and Ethical Issues - *Educational leaders understand the social, legal, and ethical issues related to technology and apply that understanding in practice.*

Performance Indicators and Performance Tasks
Educational leaders:
A. ensure equity of access to technology resources for all learners.

1. Plan and provide adequate funding for equitable implementation of the technology plan, which emphasizes access for all learners.
2. Provide accessibility to necessary technologies beyond school hours and school facilities.
3. Provide all employees equitable opportunities to develop vision, knowledge, awareness, and skills for uses of technology.

B. identify, communicate, and model social, legal, and ethical practices related to technology use.

1. Understand and uphold current intellectual property and copyright laws, rights, and responsibilities.
2. Develop, communicate, and enforce district policies that identify ethical practices related to all technology uses.
3. Identify resources that provide guidance and awareness of changes in social, ethical, and legal issues facing education.
4. Select technology resources and print materials that reflect a diverse world.
5. Develop programs to educate employees, students, and parents concerning ethical use of technology and media.

C. promote and enforce district policies for security and online safety related to the use of technology.

1. Develop, communicate, and enforce policies that identify safe online practices.
2. Develop educational programs for students, staff, and parents within the school community regarding continually changing technology issues.

D. promote and enforce district policies for environmentally safe and healthy practices in the use of technology.

1. Develop and implement district policies relative to ergonomics, facilities, equipment, and proper disposal methods.
2. Manage all technology personnel and facilities using industry-researched principles of technology implementation.

Some think to be a leader is the answer to all things. It is not. If you think you have fears now, wait - you will have even more as a leader. If you think you have responsibilities now, wait - for you will have many, many more as a leader. Doubts and failures, too, may be your lot. Leaders, all of them, experience these negatives . . . . . and then conquer them. That is the mark of a leader.

~ Thomas D. Willhite
The Book of Leadership

I wake up every morning determined both to change the world and have one hell of a good time. Sometimes this makes planning the day a little difficult.

~ E.B. White (author)

Copyright and Fair Use
Resources

Four factors:

1. Purpose of the Use (nonprofit, educational)
2. Nature of the Work (facts rather than creative use)
3. Amount of Substantiality of the Use (shorter excerpt vs. longer)
4. Effect on the Market (Are you doing it to avoid paying?)

Copyright in a Digital Age
http://www.electronic-school.com/2000/06/0600f2.html

The Educators' Lean and Mean Guide to Fair Use
http://www.techlearning.com/content/speak/articles/copy_right.html

Various copyright resource links from Sabine, LA
http://www.sabine.k12.la.us/edu/copyright.htm

MidLink – Before you post your work, do you need permission?
http://www.ncsu.edu/midlink/posting.html

Learning Resources, Copyright Issues (Teacher Tap)
http://www.eduscapes.com/tap/topic24.htm

Questions:

1. Can the students create a QuickTime clip from a segment of a videodisc of a popular movie for classroom use?
2. I want to digitize a short video clip from a television show to use in a PowerPoint program I'm developing for student use – is this ok?
3. My students want to scan magazine photographs for a class project. Can they?
4. Students want to use short segments of popular music CDs for their slide show presentations. These presentations will be seen during our school open house. Can they?
5. I want to retain multimedia projects created by students to show new students. Can I do this and take these multimedia projects to professional education conferences to show student progress?
6. I would like to share student multimedia projects over the school district's educational channel, which is received in every school district in the state. Can I?

Bill & Melinda Gates Foundation
State Challenge Grants for Leadership Development:

- ☐ **Colorado** - Colorado Student Assessment Data Mining Project & TechTools Institute

  http://www.cde.state.co.us/cdetech/et_dmp1.htm

- ☐ **Wyoming** - Wyoming Education Leadership Academy (WELA) Wyoming Equality Network & WEdGate

  http://www.k12.wy.us/DATATECH/gates/wela.html

- ☐ **Nebraska** - Leadership Talks Technology Academy (LTTA)

  http://www.nde.state.ne.us/gates/

- ☐ **Kansas** - Kansas Academy for Leadership in Technology (KAL-Tech)

  See http://www.taken.org or http://165.201.8.19/gates/

- ☐ **Missouri** - Technology Leadership Academy (TLA)

  http://successlink.org/tla/

- ☐ **North Dakota** - Technology Academy for School Leaders (TASL)

  http://ndlead.org/programs/tasl.asp

- ☐ **South Dakota** - Technology Leadership Program for School Administrators (TTLSA)

  http://www.sdttl.com/2002/Admin.htm or
  http://www.state.sd.us/deca/ddn4learning/statewide/gates/

INTERNATIONAL SOCIETY FOR TECHNOLOGY IN EDUCATION

National Educational Technology

Standards for Administrators

The National Educational Technology Standards for Administrators (NETS•A) Project is an ISTE initiative that incorporates the Technology Standards for School Administrators developed by the TSSA Collaborative.

iste

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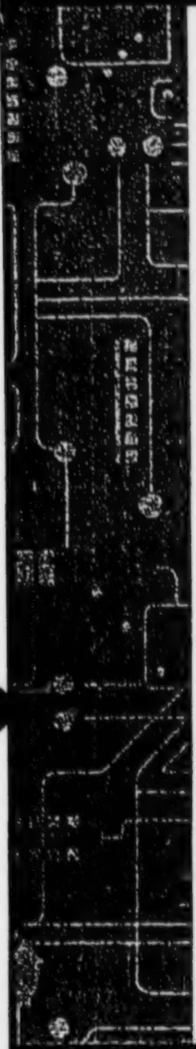
Effective School Leade



Effectively using technology across all functions of a school system is, in itself, significant systemic reform. There is a wealth of evidence showing that facilitating change in schools, and especially maintaining that change, depends heavily on capable leadership. It is imperative, therefore, that we focus on leadership for technology in schools if we are to optimize its benefits in learning, teaching, and school operations.

The International Society for Technology in Education (ISTE) and its NETS Leadership Team are pleased to announce the National Educational Technology Standards for Administrators (NETS•A) Project. The NETS•A follows on the success of the NETS for Students (NETS•S) and NETS for Teachers (NETS•T). A significant beginning to the NETS•A phase of ISTE's NETS Project has already been completed with the release of the Technology Standards for School Administrators (TSSA) document. ISTE participated in the TSSA Collaborative and had a lead role in managing the inclusive, broad-based development process. As a result, the ISTE NETS•A initiative confidently integrates and builds on the work of the TSSA Collaborative. Those who embrace NETS•T and NETS•S will realize a comfortable articulation with both the TSSA and the expanded NETS•A.

The vision of the TSSA Collaborative is that the TSSA document identifies knowledge and skills that constitute the "core"—what every P–12 administrator needs regardless of specific job role—and then extends the core to include the specific needs of administrators in each of three job roles:

- superintendent and executive cabinet,
- district-level leaders for content-specific or other district programs, and
- campus-level leaders including principals and assistant principals.

The NETS•A embraces that vision and extends it to additional administrative job roles. These standards are indicators of effective leadership for technology in schools. They define neither the minimum nor maximum level of knowledge and skills required of a leader, and are neither a comprehensive list nor a guaranteed recipe for effective technology leadership. Rather, these standards are a national consensus among educational stakeholders of what best indicates effective school leadership for comprehensive and appropriate use of technology in schools. Although created as a result of a national consensus building process, these standards should not be viewed as constraining nor construed as a rationale to inhibit new development, innovation, or progress for schools or for school leadership.

The TSSA Collaborative and the many professionals who contributed to this effort realize the wide range of roles administrators play in schools, even when titles are similar. School and system size, degree of site-based governance, community characteristics, and strengths of individual administrators are but a few of the parameters that may cause variations in actual job roles. For this reason, wise consumers of these standards will apply this national resource in ways that acknowledge the local context of school leadership.

The standards and job profiles can be applied in a rich array of situations, such as:

- Administrator preparation and professional development program design
- Assessment and evaluation

NETS PROJECT PARTNERS

ISTE NETS Project Partners

American Association of School Librarians (AASL), a division of the American Library Association (ALA)
www.ala.org/aasl

American Federation of Teachers (AFT)
www.aft.org

Association for Supervision and Curriculum Development (ASCD)
www.ascd.org

The Council of Chief State School Officers (CCSSO)
www.ccsso.org

Council for Exceptional Children (CEC)
www.cec.sped.org

International Society for Technology in Education (ISTE)
www.iste.org

National Association of Elementary School Principals (NAESP)
www.naesp.org

National Association of Secondary School Principals (NASSP)
www.nassp.org

National Council for Accreditation of Teacher Education (NCATE)
www.ncate.org

National Education Association (NEA)
www.nea.org

The NEA Foundation for the Improvement of Education (NFIE)
www.nfie.org

National School Boards Association's (NSBA) ITTE: Education Technology Programs
www.nsba.org/itte

Public Broadcasting Service (PBS)
www.pbs.org/teacherline

Software & Information Industry Association (SIIA)
www.siia.net

ISTE NETS Co-Sponsors

Apple, Inc.
www.apple.com

Intel Corporation
www.intel.com/education/

National Aeronautics and Space Administration (NASA) Classroom of the Future
www.cotf.edu

U.S. Department of Education
www.ed.gov/Technology/

hip through Technology

- Role definition and job descriptions
- Individual and system accountability
- Accreditation of schools and of administrator preparation programs
- Certification (credentialing) of administrators
- Self-assessment and goal setting
- Design of technology tools for school administrators

The audience for these standards is also varied. School boards, administrators, human resources staff, professional development staff, higher education personnel, and state education agencies will make use of this resource. Others include state and federal policymakers, industry representatives and service providers, professional organizations, parents, taxpayers, and other community constituents. This places priority, then, on clarity and simplicity of language, free from specific education jargon. The NETS•A document speaks to a variety of audiences, and it encourages accomplished leaders to stay abreast of current strategies and accepted principles as technology evolves.

An underlying assumption of these standards is that administrators should be competent users of information and technology tools common to information-age professionals. The effective 21st century administrator is a hands-on user of technology. Many of the benefits of technology are lost for administrators who rely on an intermediary to check their e-mail, manipulate critical data, or handle other technology tasks for them. While technology empowers administrators by the information it can readily produce and communicate, it exponentially empowers the administrator who masters the tools and processes that allow creative and dynamic management of available information.

During the process of developing the TSSA, the writing team members, the NETS Leadership Team, and members of the collaborating organizations identified a number of areas in which these leadership guidelines could be enhanced. The initial TSSA phase of this effort does not address the specifics of some administrative positions. ISTE's NETS•A extends the outstanding TSSA work to two new specific job roles:

- the district technology director or coordinator, and
- the building-level technology facilitator.

These two leadership roles for technology correspond to the district technology director who facilitates technology integration systemwide, and the technology facilitator for a campus who leads and supports teachers and other campus instructional staff members as they grow in the appropriate use of technology in teaching, learning, and instructional management. These two additional profiles appear in the full document, *National Educational Technology Standards for Administrators.*

Additionally, NETS•A includes an expanded look at the system-wide conditions that must be in place for even accomplished leadership to realize the full potential of technology. Documentation of authentic case studies of the effect these standards are having in real school districts is a part of this project, as is support for assessing administrators' progress toward achieving these standards. As with other NETS projects, current practitioners significantly influence support features that are an important part of NETS for Administrators.

ISTE CAPT^3 Project Partners

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Edmin.com, Inc.
MC Squared
Teacher Universe, Inc.
University of Alaska Anchorage

TSSA Collaborative

Chair: James Bosco, Western Michigan University
American Association of School Administrators (AASA)
National Association of Elementary School Principals (NAESP)
National Association of Secondary School Principals (NASSP)
National School Boards Association (NSBA)
Association of Educational Service Agencies (AESA)
International Society for Technology in Education (ISTE)
Consortium for School Networking (CoSN)
NCRTEC at North Central Regional Educational Laboratory (NCREL)
Southern Regional Education Board (SREB)
Kentucky State Department of Education
Mississippi State Department of Education
Principals' Executive Program, University of North Carolina
College of Education, Western Michigan University

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Netschools Corporation
NSBA ITTE Network
Preparing Tomorrow's Teachers to Use Technology (PT^3) program of the U.S. Department of Education
Teacher Universe, Inc.

To order or find out more about NETS•A:
Toll-Free (U.S. and Canada): 800.336.5191
International Calls: 541.302.3777
E-Mail: iste@iste.org
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ISTE NATIONAL EDUCATIONAL TECHNOLOGY STANDARDS (NETS) AND PERFORMANCE INDICATORS FOR ADMINISTRATORS

I. **LEADERSHIP AND VISION**—Educational leaders inspire a shared vision for comprehensive integration of technology and foster an environment and culture conducive to the realization of that vision.

Educational leaders:

A. facilitate the shared development by all stakeholders of a vision for technology use and widely communicate that vision.

B. maintain an inclusive and cohesive process to develop, implement, and monitor a dynamic, long-range, and systemic technology plan to achieve the vision.

C. foster and nurture a culture of responsible risk-taking and advocate policies promoting continuous innovation with technology.

D. use data in making leadership decisions.

E. advocate for research-based effective practices in use of technology.

F. advocate, on the state and national levels, for policies, programs, and funding opportunities that support implementation of the district technology plan.

II. **LEARNING AND TEACHING**—Educational leaders ensure that curricular design, instructional strategies, and learning environments integrate appropriate technologies to maximize learning and teaching.

Educational leaders:

A. identify, use, evaluate, and promote appropriate technologies to enhance and support instruction and standards-based curriculum leading to high levels of student achievement.

B. facilitate and support collaborative technology-enriched learning environments conducive to innovation for improved learning.

C. provide for learner-centered environments that use technology to meet the individual and diverse needs of learners.

D. facilitate the use of technologies to support and enhance instructional methods that develop higher-level thinking, decision-making, and problem-solving skills.

E. provide for and ensure that faculty and staff take advantage of quality professional learning opportunities for improved learning and teaching with technology.

III. **PRODUCTIVITY AND PROFESSIONAL PRACTICE**—Educational leaders apply technology to enhance their professional practice and to increase their own productivity and that of others.

Educational leaders:

A. model the routine, intentional, and effective use of technology.

B. employ technology for communication and collaboration among colleagues, staff, parents, students, and the larger community.

C. create and participate in learning communities that stimulate, nurture, and support faculty and staff in using technology for improved productivity.

D. engage in sustained, job-related professional learning using technology resources.

E. maintain awareness of emerging technologies and their potential uses in education.

F. use technology to advance organizational improvement.

IV. **SUPPORT, MANAGEMENT, AND OPERATIONS**—Educational leaders ensure the integration of technology to support productive systems for learning and administration.

Educational leaders:

A. develop, implement, and monitor policies and guidelines to ensure compatibility of technologies.

B. implement and use integrated technology-based management and operations systems.

C. allocate financial and human resources to ensure complete and sustained implementation of the technology plan.

D. integrate strategic plans, technology plans, and other improvement plans and policies to align efforts and leverage resources.

E. implement procedures to drive continuous improvements of technology systems and to support technology replacement cycles.

V. **ASSESSMENT AND EVALUATION**—Educational leaders use technology to plan and implement comprehensive systems of effective assessment and evaluation.

Educational leaders:

A. use multiple methods to assess and evaluate appropriate uses of technology resources for learning, communication, and productivity.

B. use technology to collect and analyze data, interpret results, and communicate findings to improve instructional practice and student learning.

C. assess staff knowledge, skills, and performance in using technology and use results to facilitate quality professional development and to inform personnel decisions.

D. use technology to assess, evaluate, and manage administrative and operational systems.

VI. **SOCIAL, LEGAL, AND ETHICAL ISSUES**—Educational leaders understand the social, legal, and ethical issues related to technology and model responsible decision-making related to these issues.

Educational leaders:

A. ensure equity of access to technology resources that enable and empower all learners and educators.

B. identify, communicate, model, and enforce social, legal, and ethical practices to promote responsible use of technology.

C. promote and enforce privacy, security, and online safety related to the use of technology.

D. promote and enforce environmentally safe and healthy practices in the use of technology.

E. participate in the development of policies that clearly enforce copyright law and assign ownership of intellectual property developed with district resources.

The materials contained on this panel and on the reverse side of this poster were originally produced as a project of the Technology Standards for School Administrators Collaborative.

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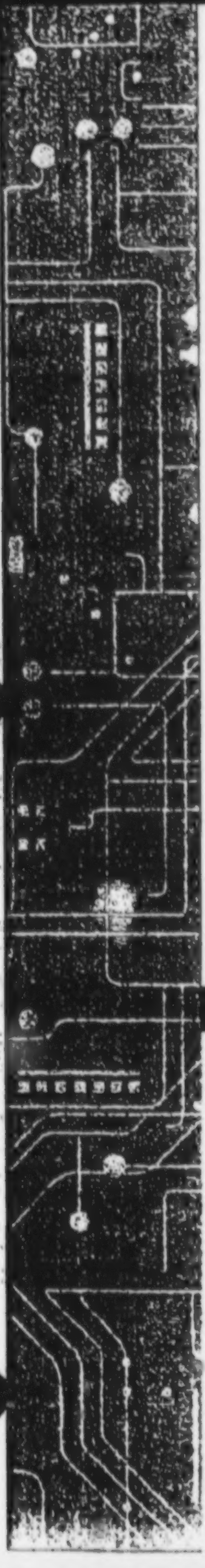
Essential Conditions for Implementing NETS for Administrators



SHARED VISION
The school board and administrators provide proactive leadership in developing a shared vision for educational technology among school personnel, parents, and the community.

EQUITABLE ACCESS
Students, teachers, staff, and administrators have equitable access to current technologies, software, and telecommunications resources.

SKILLED PERSONNEL
District leaders and support personnel are skilled in the use of technology appropriate for their job responsibilities.

PROFESSIONAL DEVELOPMENT
District leaders and support personnel have consistent access to technology-related professional development for their job assignments.

TECHNICAL ASSISTANCE
Personnel have technical assistance for maintaining and using technology.

CONTENT STANDARDS AND CURRICULUM RESOURCES
Instructional personnel and school leaders are knowledgeable about content and technology standards, related curriculum resources, teaching methodologies, and the use of technology to support learning.

STUDENT-CENTERED TEACHING
Teaching in all settings includes the use of technology to facilitate student-centered approaches to learning.

ASSESSMENT AND ACCOUNTABILITY
The school district has a system for the continual assessment of effective technology use for improving student learning.

COMMUNITY SUPPORT
The district maintains partnerships and communications with parents, businesses, and the community to support technology use within the district.

SUPPORT POLICIES
The district has policies, financial plans, and incentive structures to support the use of technology in learning and in operations of the district.

EXTERNAL CONDITIONS
Policies, requirements, and initiatives at the national, regional, and state levels support the district in the effective implementation of technology for achieving national, state, and local curriculum and technology standards.

NETS for Administrators =
TSSA + Essential Conditions + Profiles for District and Building Technology Leaders

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Superintendent

Superintendents who effectively lead the integration of technology typically perform the following tasks. Effective superintendents:

I. LEADERSHIP AND VISION

1. ensure that the vision for the use of technology is congruent with the overall district vision.
2. engage representatives from all stakeholder groups in the development, implementation, and ongoing assessment of a district technology plan consistent with the district improvement plan.
3. advocate to the school community, the media, and the community at large for effective technology use in schools for improved student learning and efficiency of operations.

II. LEARNING AND TEACHING

4. provide equitable access for students and staff to technologies that facilitate productivity and enhance learning.
5. communicate expectations consistently for the use of technology to increase student achievement.
6. ensure that budget priorities reflect a focus on technology and its relationships to enhanced learning and teaching.

III. PRODUCTIVITY AND PROFESSIONAL PRACTICE

7. establish a culture that encourages responsible risk-taking with technology while requiring accountability for results.
8. maintain an emphasis on technology fluency among staff across the district and provide staff development opportunities to support high expectations.
9. use current information tools and systems for communication, management of schedules and resources, performance assessment, and professional learning.

IV. SUPPORT, MANAGEMENT, AND OPERATIONS

10. provide adequate staffing and other resources to support technology infrastructure and integration across the district.
11. ensure, through collaboration with district and campus leadership, alignment of technology efforts with the overall district improvement efforts in instructional management and district operations.

V. ASSESSMENT AND EVALUATION

12. engage administrators in using districtwide and disaggregated data to identify improvement targets at the campus and program levels.
13. establish evaluation procedures for administrators that assess demonstrated growth toward achieving technology standards for school administrators.

VI. SOCIAL, LEGAL, AND ETHICAL ISSUES

14. ensure that every student in the district engages in technology-rich learning experiences.
15. recommend policies and procedures that protect the security and integrity of the district infrastructure and the data resident on it.
16. develop policies and procedures that protect the rights and confidentiality of students and staff.

ISTE NATIONAL EDUC

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E. provide for and ensure that faculty and staff take advantage of quality professional learning opportunities for improved learning and teaching with technology.

District Program Director

District program directors who effectively lead the integration of technology typically perform the following tasks. Effective program directors:

I. LEADERSHIP AND VISION

1. ensure that program technology initiatives are aligned with the district technology vision.
2. represent program interests in the development and systematic review of a comprehensive district technology plan.
3. advocate for program use of promising practices with technology to achieve program goals.

II. LEARNING AND TEACHING

4. participate in developing and providing electronic resources that support improved learning for program participants.
5. provide rich and effective staff development opportunities and ongoing support that promote the use of technology to enhance program initiatives and activities.
6. ensure that program curricula and services embrace changes brought about by the proliferation of technology within society.

III. PRODUCTIVITY AND PROFESSIONAL PRACTICE

7. use technology and connectivity to share promising strategies, interesting case studies, and student and faculty learning opportunities that support program improvement.
8. model, for program staff, effective uses of technology for professional productivity such as in presentations, record keeping, data analysis, research, and communications.
9. use online collaboration to build and participate in collaborative learning communities with directors of similar programs in other districts.

IV. SUPPORT, MANAGEMENT, AND OPERATIONS

10. implement technology initiatives that provide instructional and technical support as defined in the district technology plan.
11. determine the financial needs of the program, develop budgets, and set time lines to realize program technology targets.

V. ASSESSMENT AND EVALUATION

12. continuously monitor and analyze performance data to guide the design and improvement of program initiatives and activities.
13. employ multiple measures and flexible assessment strategies to determine staff technology proficiency within the program and to guide staff development efforts.

VI. SOCIAL, LEGAL, AND ETHICAL ISSUES

14. involve program participants, clients, and staff in dealing with issues related to equity of access and equity of technology-rich opportunities.
15. educate program personnel about technology-related health, safety, legal, and ethical issues, and hold them accountable for decisions and behaviors related to those issues.
16. inform district and campus leadership of program-specific issues related to privacy, confidentiality, and reporting of information that might affect technology system and policy requirements.

TIONAL TECHNOLOGY STANDARDS (NETS) AND PERFORMANCE IN

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E. implement procedures to drive continuous improvements of technology systems and to support technology replacement cycles.

Principal

Principals who effectively lead the integration of technology typically perform the following tasks. Effective principals:

I. LEADERSHIP AND VISION

1. participate in an inclusive district process through which stakeholders formulate a shared vision that clearly defines expectations for technology use.
2. develop a collaborative, technology-rich school improvement plan, grounded in research and aligned with the district strategic plan.
3. promote highly effective practices in technology integration among faculty and other staff.

II. LEARNING AND TEACHING

4. assist teachers in using technology to access, analyze, and interpret student performance data, and in using results to appropriately design, assess, and modify student instruction.
5. collaboratively design, implement, support, and participate in professional development for all instructional staff that institutionalizes the effective integration of technology for improved student learning.

III. PRODUCTIVITY AND PROFESSIONAL PRACTICE

6. use current technology-based management systems to access and maintain personnel and student records.
7. use a variety of media and formats, including telecommunications and the school Web site, to communicate, interact, and collaborate with peers, experts, and other education stakeholders.

IV. SUPPORT, MANAGEMENT, AND OPERATIONS

8. provide campuswide staff development for sharing work and resources across commonly used formats and platforms.
9. allocate campus discretionary funds and other resources to advance implementation of the technology plan.
10. advocate for adequate, timely, and high-quality technology support services.

V. ASSESSMENT AND EVALUATION

11. promote and model the use of technology to access, analyze, and interpret campus data to focus efforts for improving student learning and productivity.
12. implement evaluation procedures for teachers that assess individual growth toward established technology standards and guide professional development planning.
13. include effectiveness of technology use in the learning and teaching process as one criterion in assessing the performance of instructional staff.

VI. SOCIAL, LEGAL, AND ETHICAL ISSUES

14. secure and allocate technology resources to enable teachers to better meet the needs of all learners on campus.
15. adhere to and enforce among staff and students the district's acceptable use policy and other policies and procedures related to security, copyright, and technology use.
16. participate in the development of facility plans that support and focus on health and environmentally safe practices related to the use of technology.

CATORS FOR ADMINISTRATORS

V. ASSESSMENT AND EVALUATION— Educational leaders use technology to plan and implement comprehensive systems of effective assessment and evaluation.

Educational leaders:

A. use multiple methods to assess and evaluate appropriate uses of technology resources for learning, communication, and productivity.

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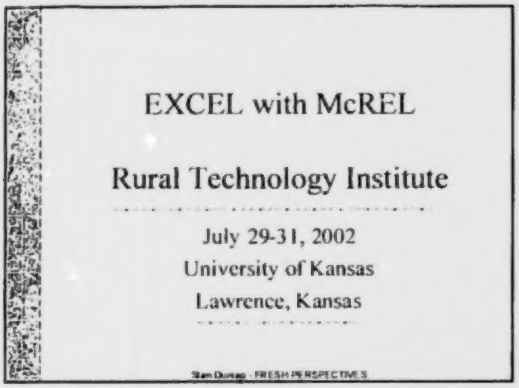
Data Driven Decision Making for Administrators

Stan Dunlap, Fresh Perspectives
Tuesday, July 30, 2002

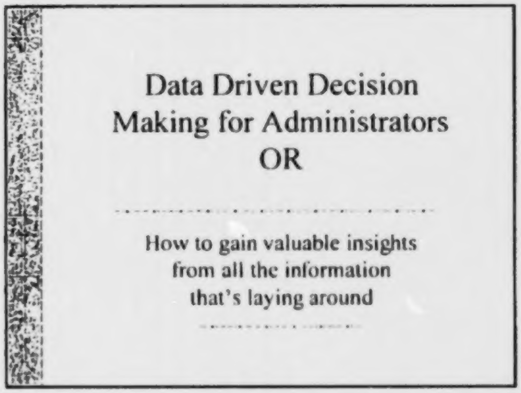


EXCEL with McREL

Rural Technology Institute

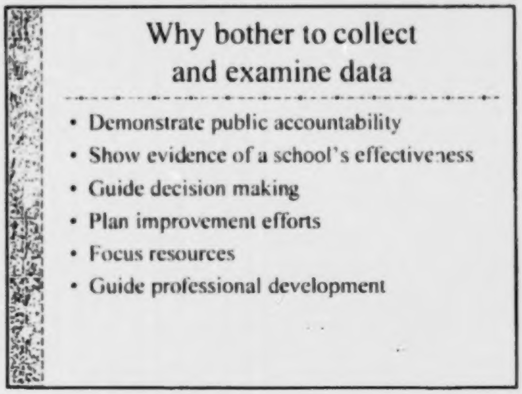
July 29-31, 2002
University of Kansas
Lawrence, Kansas

Stan Dunlap · FRESH PERSPECTIVES



Data Driven Decision Making for Administrators OR

How to gain valuable insights
from all the information
that's laying around



Why bother to collect and examine data

- Demonstrate public accountability
- Show evidence of a school's effectiveness
- Guide decision making
- Plan improvement efforts
- Focus resources
- Guide professional development

What do we need to do?

- Learn to use computer technology to simplify the process
- Learn the skills to convert "data" into useful information
- Learn the skills to "ask the right questions"

Common reasons for looking at data

- Answer basic questions about schools
  - How are we doing?
  - What are our strengths?
  - Where do we need to improve?

What can we do with it?

- Determine strengths & weaknesses
- Focus limited resources
- Evaluate instruction
- Design & alter instruction
- Increase student achievement
- Demonstrate accountability
- Enhance personal efficacy

Data questions

- What does your school DO with data?
- What kind of data is kept at your school?
- Who keeps it?

To begin working with data, ponder the following:

- What evidence would demonstrate that we are fulfilling the commitments in our vision and mission statements?
- Do we have any existing goals for which we don't have baseline data?
- What are the assumptions we make about students and their learning?
- What data might help resolve the smoldering issues in our district?

Already got a smoldering issue? Try the fishbone . . .

- Identify the issue
- Identify the "bones" of possible contributions to the problem
- Prioritize
- Strategic Planning workshop or process

Tools for analyzing data

- Spreadsheet
  - Microsoft Excel
- Word Processing
  - Word

Stan Dunlap

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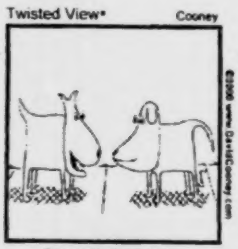
Twisted View*
Cooney
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"I hope school soon starts.
I'm dying for some math homework."

WELCOME

to

EXCEL with McREL
for
Educational Administrators

McREL RTI

Lawrence, Kansas

July 29-31, 2002

Stan Dunlap
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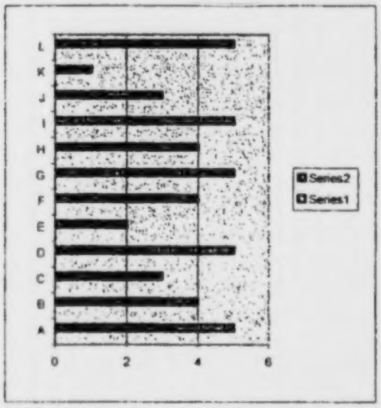
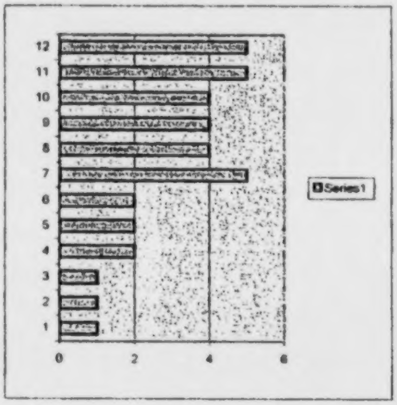
McREL Rural Technology Institute

	Data Usage					
Participant	Item # 1	Item # 2	Item # 3	Item # 4	Item # 5	
A	5	1	3	4	2	Count
B	4	1	2	5	4	Total
C	3	1	1	5	4	Average
D	5	2	2	5	4	Average Deviation
E	2	2	3	5	4	Median
F	4	2	4	5	3	
G	5	5	3	4	4	
H	4	4	2	4	3	
I	5	4	3	5	4	
J	3	4	2	5	2	
K	1	5	3	5	1	
L	5	5	5	5	5	



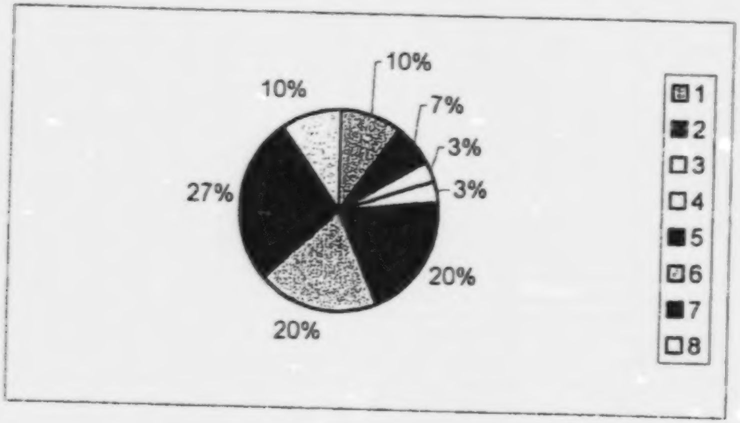


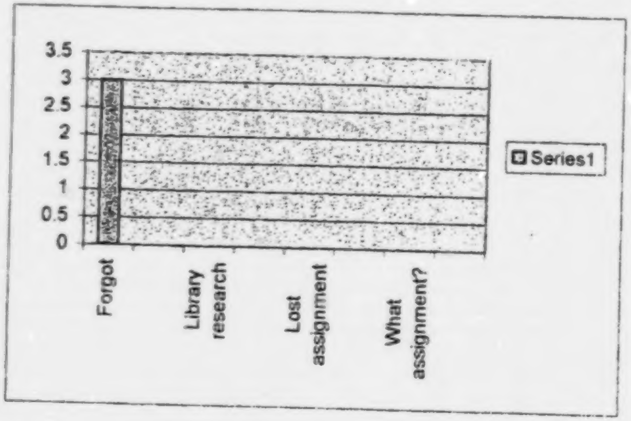
Participant	Item # 1	Item # 2	Item # 3	Item # 4	Item # 5
Delilah	5	1	3	4	2
Harriet	4	1	2	5	4
Edgar	3	1	1	5	4
Ike	5	2	2	5	4
Brenda	2	2	3	5	4
Jeanne	4	2	4	5	3
Freda	5	5	3	4	4
Albert	4	4	2	4	3
George	5	4	3	5	4
Leslie	3	4	2	5	2
Chuck	1	5	3	5	1
Kim	5	5	5	5	5

District Name & District #
Current School Name and School #
New School Name & School #
Grade
Content Area
Student Name

Late Homework Check Sheet

EXCUSES	Frequency	Total	OR									
Forgot	xxx	3		1	1	1						3
Kid brother needed help with homework	xx	2		1	1							
Library research required extra time	x	1		1								
Mom had a baby	x	1		1								
Lost assignment	xxxxxx	6		1	1	1	1	1	1			
Did not understand the assignment	xxxxxx	6		1	1	1	1	1	1			
What assignment?	xxxxxxxx	8		1	1	1	1	1	1	1	1	
Watched TV instead of doing assignment	xxx	3		1	1	1						
	TOTAL											





Halloween Carnival Survey

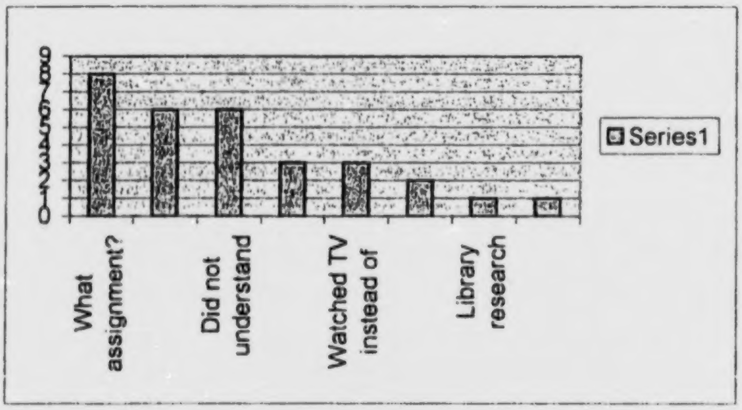
Question (or topic)	GREAT	OK	POOR
1. The game booths were ...			
2. The haunted house was ...			
3. The food served by the cafeteria was ...			
4. The costume parade was ...			
5. What was your favorite game?	____________		
6. Did you participate in the costume parade?	Yes ____	No ____	
7. What was your favorite food at the carnival?	____________		

Pareto Chart

1. Construct a graph with a vertical and horizontal axis
2. Label each axis
3. Divide the vertical axis into equal increments
4. Include a title being studied along the horizontal axis
5. Plot the data as bars.
6. Start with the largest category at the far left.

Late Homework Check Sheet

EXCUSES	Total
What assignment?	8
Lost assignment	6
Did not understand the assignment	6
Forgot	3
Watched TV instead of doing assignment	3
Kid brother needed help with homework	2
Library research required extra time	1
Mom had a baby	1



Matrix Diagram

1. Identify the sets of data to be compared
2. Put the first set of items along the vertical axis.
3. Put the second set of items along the horizontal axis.
4. Draw in the grid lines.
5. Determine the symbols to be used to rate the relationships & provide a legend.

+	Strong relationship
0	Some relationship
X	No relationship

6. Enter the appropriate symbols into each box.

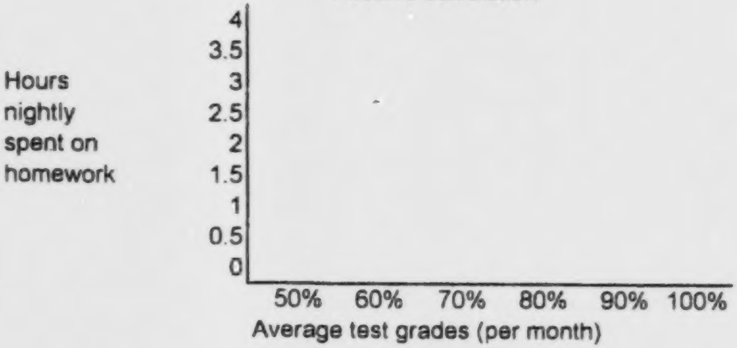
Choosing a project that's best for you

	Build a replica of the Mayflower	Write a story about a pilgrim	Draw a map of the Mayflower's journey	Write a report on the first Thanks-giving	Perform a play about the Pilgrims	Give an oral report about hardships on the Mayflower
Reading core material						
Doing research						
Art work						
Speaking in front of class						
Craft skills						
Team Work						
Writing						

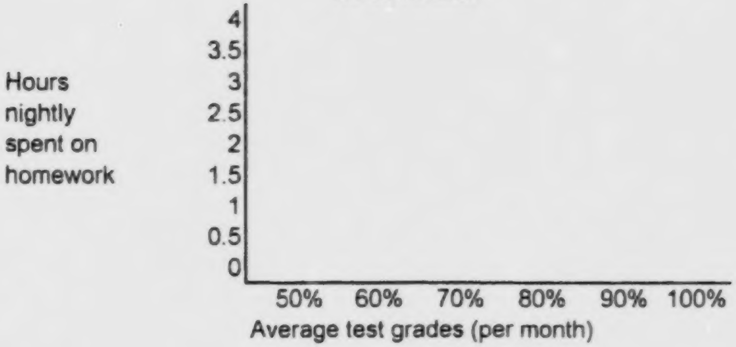
Scatter Diagram

1. Construct a graph with a verrtical and horizontal axis
2. Label each axis
3. Divide each axis into even increments with the selected units of measure
4. Plot the data points
5. Title the diagram

Positive correlation



No correlation



Run Chart

1. Construct a graph with a verrtical and horizontal axis
2. Label each axis
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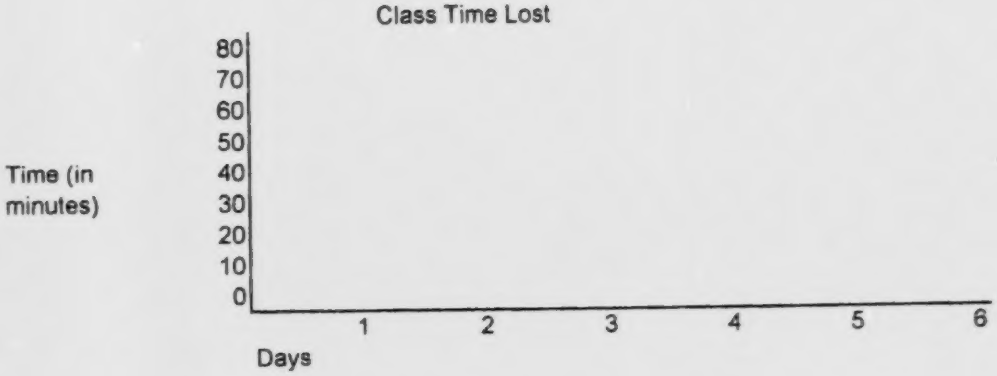

GRADE	DISTRICT	DISTRICT NUMBER	SCHOOL	SCHOOL NUMBER	# STUDENTS 1997	# UNSAT 1997	% UNSAT 1997	# PARTIALLY PROF. 1997
4	STATE RESULTS				51691	8739	16.9	12969
4	District One	1040			1168	87	7.4	214
4	District One	1040	one	17				
4	District One	1040	two	19				
4	District One	1040	three	249	87	3	3.4	9
4	District One	1040	four	1627				
4	District One	1040	fivr	9800				
4	District One	1040	six	2248	60	5	8.3	12
4	District One	1040	seven	2524	81	4	4.9	14
4	District One	1040	eight	2800	73	8	11.0	12
4	District One	1040	nine	3104	113	3	2.7	17
4	District One	1040	ten	3238	113	9	8.0	18
4	District One	1040	eleven	3985	126	15	11.9	31
4	District One	1040	twelve	6158	82	1	1.2	14
4	District One	1040	thirteen	6942	61	11	18.0	9
4	District One	1040	fourteen	6960	98	12	12.2	24
4	District One	1040	fifteen	7159	119	13	10.9	35
4	District One	1040	sixteen	7460	73	1	1.4	9
4	District One	1040	seventeen	9714	82	2	2.4	10
4	District Two	180	TOTAL		2248	560	24.9	624
4	District Two	180	A one	214	70	28	40.0	24
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FISCAL YEAR or TERM

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	Support Program			
2	Salaries (0100)	6,000	1,200	7,200
3	Employee Benefits (0	1,920	384	2,304
4	Purchased Professio	1,800	1,200	3,000
5	Other Purchased Services (0500)			0
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14	Equipment (0730)*	2,000	500	2,500
15	***Total (line 11 plus l***	**$14,255**	**$6,330**	**$20,585**

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??? (???) ???-????
Typed Name of LEA Authorize Phone Number

(to be forwarded in hard ??/??/??
Signature of LEA Authorized R Date

DO NOT WRITE BELOW THIS LINE

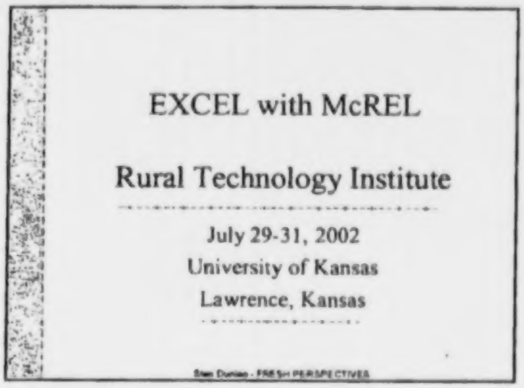
Signature indicating Funder Ap Date

BEST COPY AVAILABLE

BUDGET WORKSHEET

					TOTAL
Salary	1 Part time coordinator				$6,000
	Note: $1200 paid by district				
Purchased services - Consultant 3 days @ $600/day					$1,800
Travel for consultant		# nights	cost/night		
		3	$75		$225
	per diem	3	$30		$90
	Airfare				$600
				Subtotal	$915
Participant stipends		per hour	# part	# hours	
		$15	12	10	$1,800
	Note: matched by district				
Supplies per participant					
		$12	12		$144
				Avg miles	
Travel reimbursement		per mile			
		0.25	12	60	$180
Use of district bus for site visits 2 trips @$95					$190
Equipment - computer, printer, scanner, modem					$2,000
	Related supplies (district in-kind)				$500
Use of district equipment					$500

Last	First	School	Address	City, ST ZI	Phone	FAX	e-mail
Smith	Adam	Ft. Hays El	1234 Old H	Hays, KS 67876			
Adams	Smitty						
Evans	Flo	Haystack E	3456 Old Hays Road				
Sanchez	Manuel						
Geronimo	Ivan	Hays Middl	2345 New Hays Road				
Johnson	Freda						
Smythe	Aletha	Hays High	2455 New Hays Road				
Jackson	Lars						
D'Amato	Angelo						

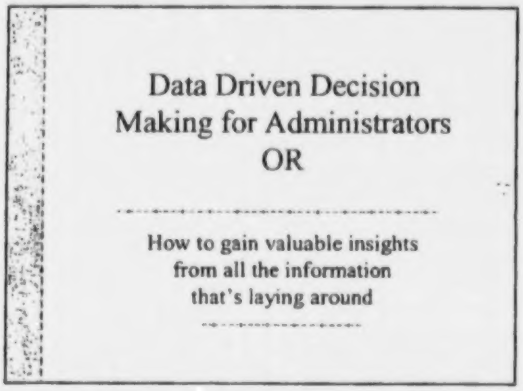


EXCEL with McREL

Rural Technology Institute

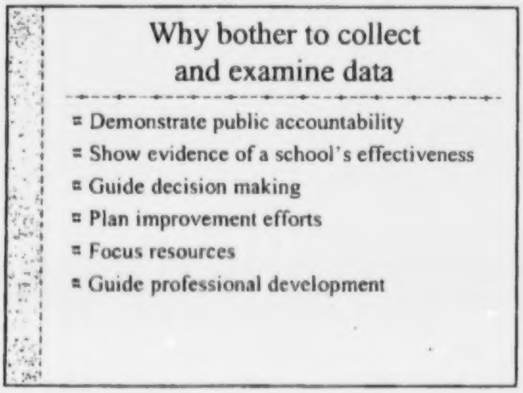
July 29-31, 2002
University of Kansas
Lawrence, Kansas

[illegible] - FRESH PERSPECTIVES



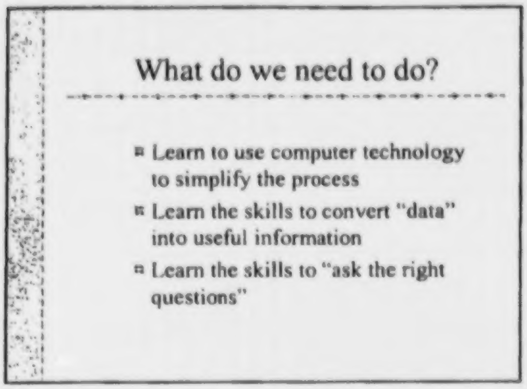
Data Driven Decision Making for Administrators OR

How to gain valuable insights
from all the information
that's laying around



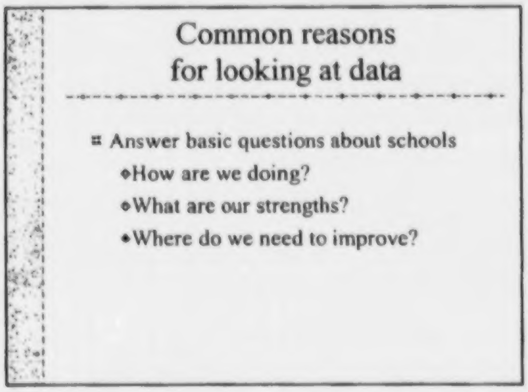
Why bother to collect and examine data

- Demonstrate public accountability
- Show evidence of a school's effectiveness
- Guide decision making
- Plan improvement efforts
- Focus resources
- Guide professional development



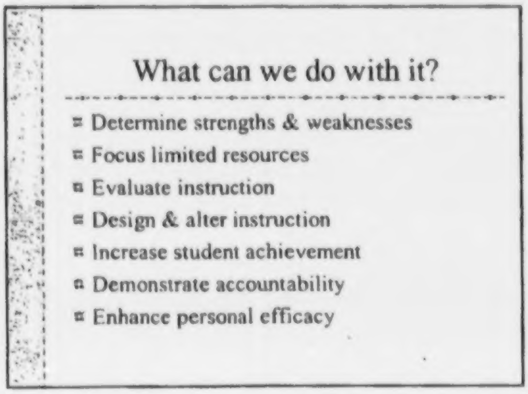
What do we need to do?

- Learn to use computer technology to simplify the process
- Learn the skills to convert "data" into useful information
- Learn the skills to "ask the right questions"



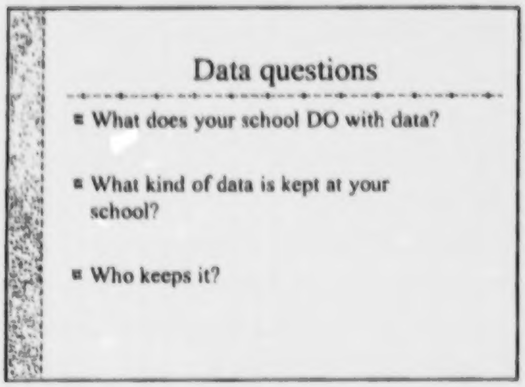
Common reasons for looking at data

- Answer basic questions about schools
  - How are we doing?
  - What are our strengths?
  - Where do we need to improve?



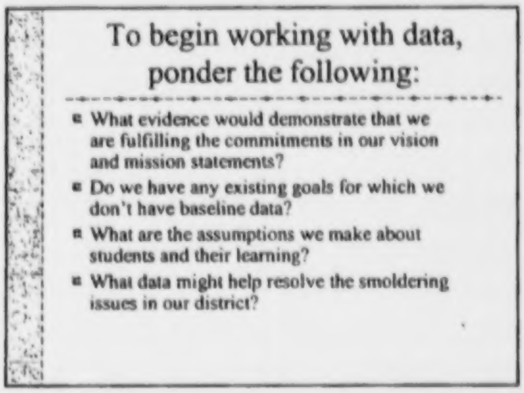
What can we do with it?

- Determine strengths & weaknesses
- Focus limited resources
- Evaluate instruction
- Design & alter instruction
- Increase student achievement
- Demonstrate accountability
- Enhance personal efficacy



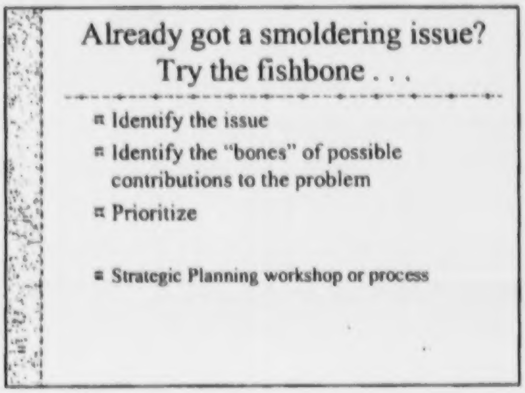
Data questions

- What does your school DO with data?
- What kind of data is kept at your school?
- Who keeps it?



To begin working with data, ponder the following:

- What evidence would demonstrate that we are fulfilling the commitments in our vision and mission statements?
- Do we have any existing goals for which we don't have baseline data?
- What are the assumptions we make about students and their learning?
- What data might help resolve the smoldering issues in our district?



Already got a smoldering issue? Try the fishbone . . .

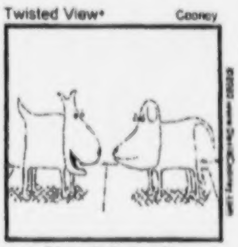
- Identify the issue
- Identify the "bones" of possible contributions to the problem
- Prioritize
- Strategic Planning workshop or process

Tools for analyzing data

- Spreadsheet
  - Microsoft Excel
- Word Processing
  - Word

Stan Dunlap

FRESH PERSPECTIVES
37 Verde Lane, Durango, Co
81301
970-247-0028
s_dunlap@frontier.net



"I hope school soon starts.
I'm dying for some math homework."

WELCOME

to

EXCEL with McREL

for

Educational Administrators

McREL RTI

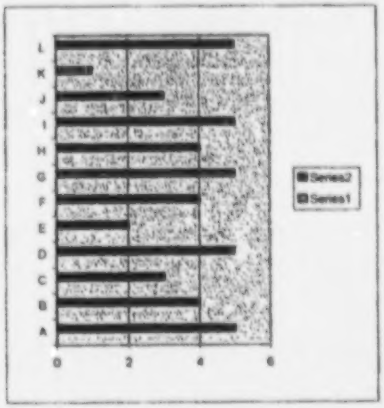
Lawrence, Kansas

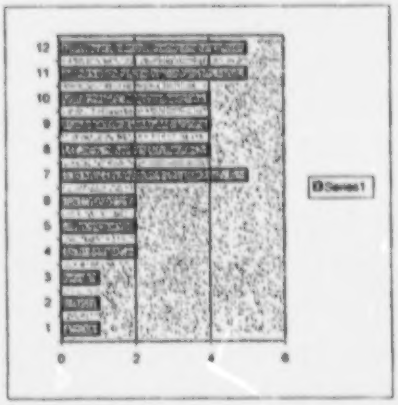
July 29-31, 2002

Stan Dunlap
FRESH PERSPECTIVES
37 Verde Lane
Durango, CO 81301
970-247-0028
s_dunlap@frontier.net

Data Usage

Participant	Item # 1	Item # 2	Item # 3	Item # 4	Item # 5	
A	5	1	3	4	2	Count
B	4	1	2	5	4	Total
C	3	1	1	5	4	Average
D	5	2	2	5	4	Average Deviation
E	2	2	3	5	4	Median
F	4	2	4	5	3	
G	5	5	3	4	4	
H	4	4	2	4	3	
I	5	4	3	5	4	
J	3	4	2	5	2	
K	1	5	3	5	1	
L	5	5	5	5	5	



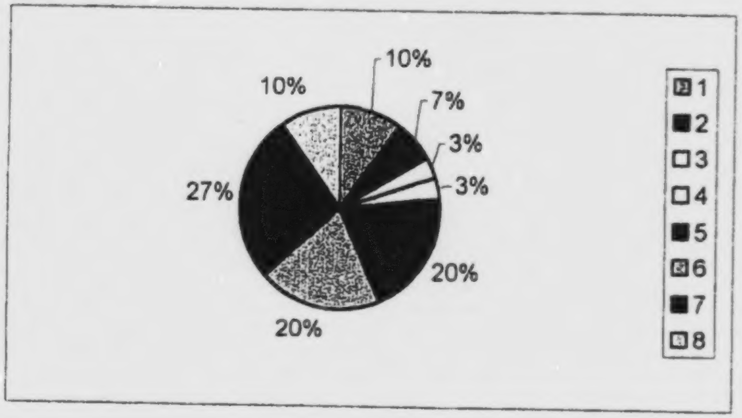


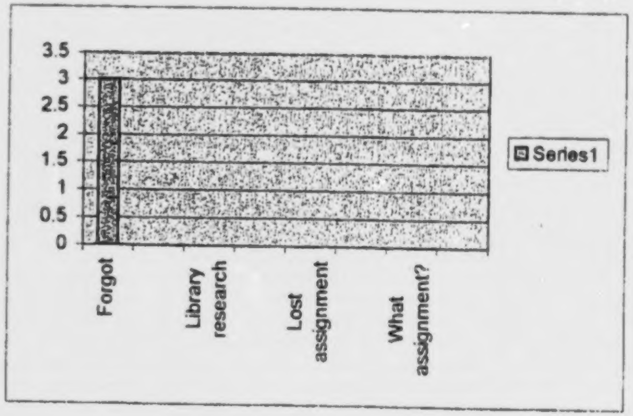
Participant	Item # 1	Item # 2	Item # 3	Item # 4	Item # 5
Delilah	5	1	3	4	2
Harriet	4	1	2	5	4
Edgar	3	1	1	5	4
Ike	5	2	2	5	4
Brenda	2	2	3	5	4
Jeanne	4	2	4	5	3
Freda	5	5	3	4	4
Albert	4	4	2	4	3
George	5	4	3	5	4
Leslie	3	4	2	5	2
Chuck	1	5	3	5	1
Kim	5	5	5	5	5

District Name & District #
Current School Name and School #
New School Name & School #
Grade
Content Area
Student Name

Late Homework Check Sheet

EXCUSES	Frequency	Total	OR								
Forgot	xxx	3	1	1	1						3
Kid brother needed help with homework	xx	2	1	1							
Library research required extra time	x	1	1								
Mom had a baby	x	1	1								
Lost assignment	xxxxxx	6	1	1	1	1	1	1			
Did not understand the assignment	xxxxxx	6	1	1	1	1	1	1			
What assignment?	xxxxxxxx	8	1	1	1	1	1	1	1	1	
Watched TV instead of doing assignment	xxx	3	1	1	1						
	TOTAL										





Halloween Carnival Survey

Question (or topic)	GREAT	OK	POOR
1. The game booths were …			
2. The haunted house was …			
3. The food served by the cafeteria was …			
4. The costume parade was …			

5. What was your favorite game? ____________________

6. Did you participate in the costume parade? Yes ____ No ____

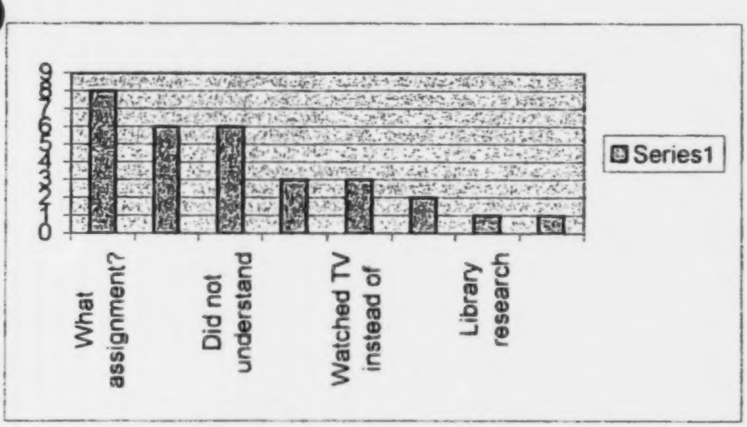
7. What was your favorite food at the carnival? ____________________

Pareto Chart

1. Construct a graph with a vertical and horizontal axis
2. Label each axis
3. Divide the vertical axis into equal increments
4. Include a title being studied along the horizontal axis
5. Plot the data as bars.
6. Start with the largest category at the far left.

Late Homework Check Sheet

EXCUSES	Total
What assignment?	8
Lost assignment	6
Did not understand the assignment	6
Forgot	3
Watched TV instead of doing assignment	3
Kid brother needed help with homework	2
Library research required extra time	1
Mom had a baby	1



Matrix Diagram

1. Identify the sets of data to be compared
2. Put the first set of items along the vertical axis.
3. Put the second set of items along the horizontal axis.
4. Draw in the grid lines.
5. Determine the symbols to be used to rate the relationships & provide a legend.

+	Strong relationship
0	Some relationship
X	No relationship

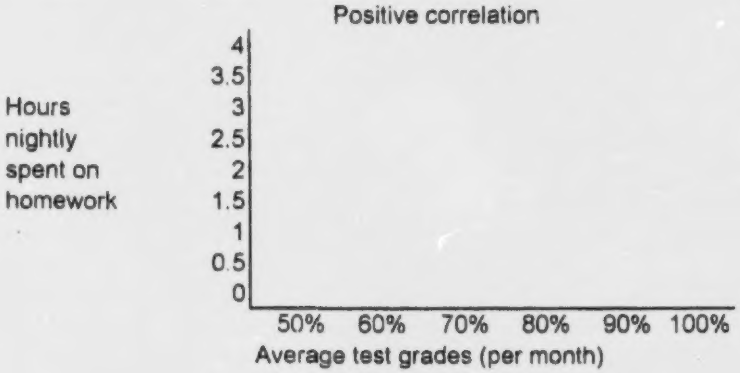
6. Enter the appropriate symbols into each box.

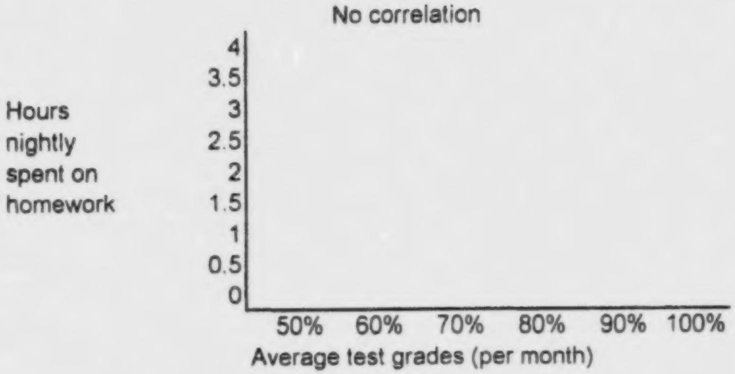
Choosing a project that's best for you

	Build a replica of the Mayflower	Write a story about a pilgrim	Draw a map of the Mayflower's journey	Write a report on the first Thanks-giving	Perform a play about the Pilgrims	Give an oral report about hardships on the Mayflower
Reading core material						
Doing research						
Art work						
Speaking in front of class						
Craft skills						
Team Work						
Writing						

Scatter Diagram

1. Construct a graph with a verrtical and horizontal axis
2. Label each axis
3. Divide each axis into even increments with the selected units of measure
4. Plot the data points
5. Title the diagram





Run Chart

1. Construct a graph with a verrtical and horizontal axis
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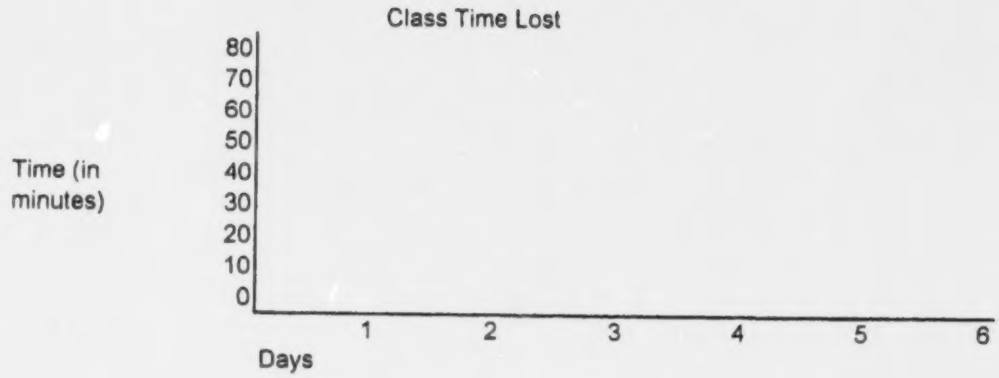

GRADE	DISTRICT	DISTRICT NUMBER	SCHOOL	SCHOOL NUMBER	# STUDENTS 1997	# UNSAT 1997	% UNSAT 1997	# PARTIALLY PROF 1997
4	STATE RESULTS				51691	8739	16.9	12969
4	District One	1040			1168	87	7.4	214
4	District One	1040	one	17				
4	District One	1040	two	19				
4	District One	1040	three	249	87	3	3.4	9
4	District One	1040	four	1627				
4	District One	1040	fivr	9800				
4	District One	1040	six	2248	60	5	8.3	12
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??? (???) ???-????
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(to be forwarded in hard ??/??/??
Signature of LEA Authorized R Date

DO NOT WRITE BELOW THIS LINE

Signature indicating Funder Ap Date

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Evans	Flo	Haystack E	3456 Old Hays Road				
Sanchez	Manuel						
Geronimo	Ivan	Hays Middl	2345 New Hays Road				
Johnson	Freda						
Smythe	Aletha	Hays High	2455 New Hays Road				
Jackson	Lars						
D'Amato	Angelo						

Technology Policy Briefing

Laura Lefkowitz, McREL
Tuesday, July 30, 2002

McREL

2002 Annual
Rural Technology Institute

July 29-31, 2002
Lawrence, Kansas

Mid-continent Research for Education and Learning (McREL)
2550 South Parker Road, Suite 500
Aurora, Colorado 80014
Phone: 303-337-0990

Overview of Presentation

- The Big Picture –
  - What is the state of educational technology in America today?
  - What is the role of schools in promoting access to and use of technology?
- Federal Educational Technology Policies and Initiatives
- Current Educational Technology Activities in the Central Region
- Best Practices
- Policy Implications and Advocacy

Introduction

"By harnessing technology, we can expand access to learning and close the achievement gap in America. And that's the critical mission of the No Child Left Behind Act of 2001. These new education reforms say loud and clear: One size does not fit all when it comes to educating our children. We must challenge the old ways. We must be innovative and creative in our thinking. We must do *whatever it takes* to help ensure that every child is educated."

Rod Paige
U.S. Secretary of Education
At "No Child Left Behind
Forum on E-Learning"
Denver, CO - July 12, 2002

The Big Picture

- Information technology's share of the U.S. economy nearly doubled between 1977 and 1998, from 4.2 percent to 8.2 percent.
- Information technologies contributed more than a third of real U.S. economic growth between 1995 and 1997.
- In 1994, 3 million people used the Internet.
- By 1998, more than 147 million people worldwide used the Internet.
- The number of Internet users is projected to grow to 720 million by 2005.
- Traffic on the Internet is doubling every 100 days.

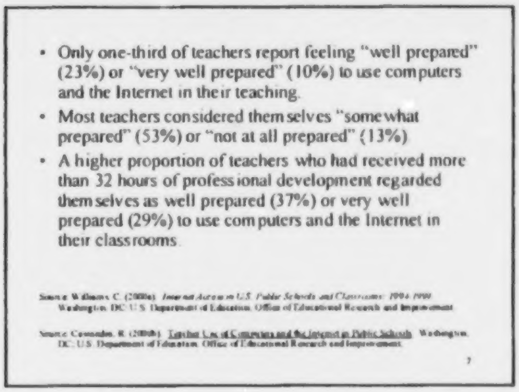
- Households with incomes of $75,000 and higher are 20 times more likely to have access to the Internet than those at the lowest income levels, and more than 9 times as likely to have a computer at home.
- Caucasians are more likely to have access to the Internet from home than African-Americans or Hispanics have from any location.
- Regardless of income level, Americans living in rural areas are lagging behind in Internet access. In addition, at the lowest income levels, urban residents are more than twice as likely to have Internet access than those earning the same income in rural areas.

Source: Meares, C.A. & Sargent, J.F. (1999). The Digital Workforce: Building Infotech Skills at the Speed of Innovation. Washington, DC: U.S. Department of Commerce, Office of Technology Policy.

Source: U.S. Department of Commerce, National Telecommunications and Information Administration (1999). *Falling Through the Net: Defining the Digital Divide.*

What is the Role of Schools in Providing Access to Technology?

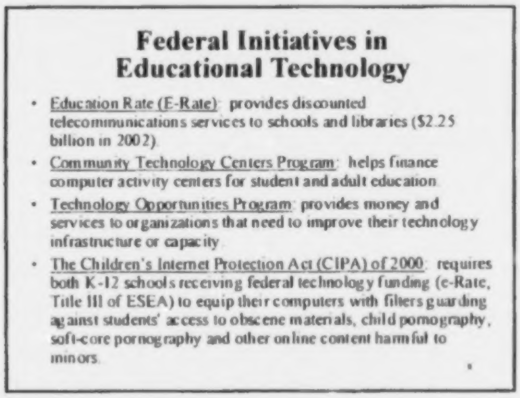
- Schools have a critical role to play in narrowing the digital divide and helping students become technologically literate.
- U.S. schools connected to the Internet rose from 35% in 1994 to 95% in 1999.
- In 1999, all schools, regardless of instructional level, poverty concentration, and metropolitan status, were equally likely to have Internet access, although high-poverty schools were significantly less likely to have Internet access in their classrooms.



- Only one-third of teachers report feeling "well prepared" (23%) or "very well prepared" (10%) to use computers and the Internet in their teaching.
- Most teachers considered themselves "somewhat prepared" (53%) or "not at all prepared" (13%).
- A higher proportion of teachers who had received more than 32 hours of professional development regarded themselves as well prepared (37%) or very well prepared (29%) to use computers and the Internet in their classrooms.

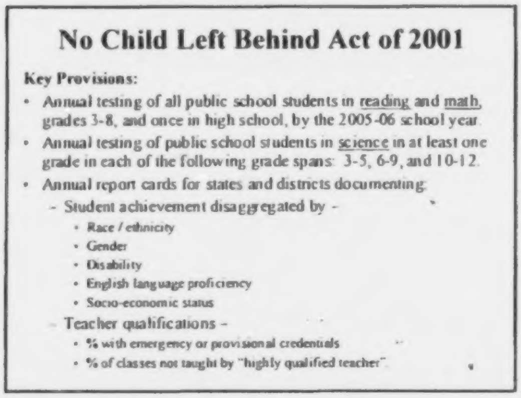
Source: Williams, C. (2000a). *Internet Access in U.S. Public Schools and Classrooms: 1994-1999.* Washington, DC: U.S. Department of Education, Office of Educational Research and Improvement.

Source: [illegible], R. (2000b). Teacher Use of Computers and the Internet in Public Schools. Washington, DC: U.S. Department of Education, Office of Educational Research and Improvement.



Federal Initiatives in Educational Technology

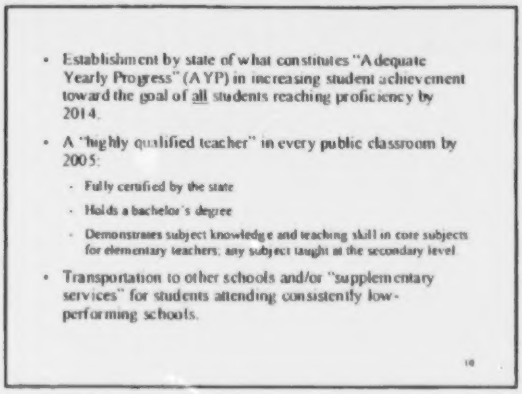
- Education Rate (E-Rate): provides discounted telecommunications services to schools and libraries ($2.25 billion in 2002).
- Community Technology Centers Program: helps finance computer activity centers for student and adult education.
- Technology Opportunities Program: provides money and services to organizations that need to improve their technology infrastructure or capacity.
- The Children's Internet Protection Act (CIPA) of 2000: requires both K-12 schools receiving federal technology funding (e-Rate, Title III of ESEA) to equip their computers with filters guarding against students' access to obscene materials, child pornography, soft-core pornography and other online content harmful to minors.



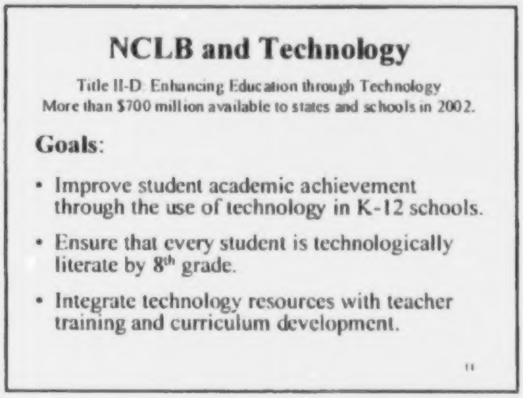
No Child Left Behind Act of 2001

Key Provisions:

- Annual testing of all public school students in reading and math, grades 3-8, and once in high school, by the 2005-06 school year.
- Annual testing of public school students in science in at least one grade in each of the following grade spans: 3-5, 6-9, and 10-12.
- Annual report cards for states and districts documenting:
  - Student achievement disaggregated by -
    - Race / ethnicity
    - Gender
    - Disability
    - English language proficiency
    - Socio-economic status
  - Teacher qualifications -
    - % with emergency or provisional credentials
    - % of classes not taught by "highly qualified teacher".



- Establishment by state of what constitutes "Adequate Yearly Progress" (AYP) in increasing student achievement toward the goal of all students reaching proficiency by 2014.
- A "highly qualified teacher" in every public classroom by 2005:
  - Fully certified by the state
  - Holds a bachelor's degree
  - Demonstrates subject knowledge and teaching skill in core subjects for elementary teachers; any subject taught at the secondary level
- Transportation to other schools and/or "supplementary services" for students attending consistently low-performing schools.

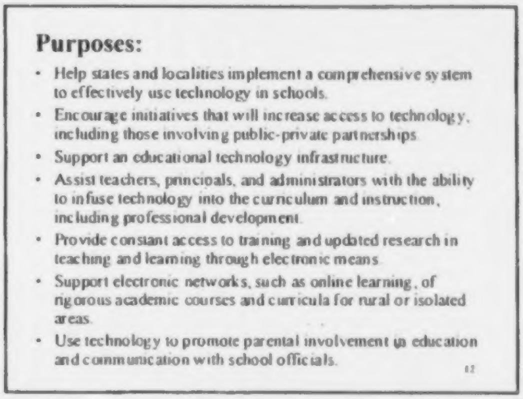


NCLB and Technology

Title II-D: Enhancing Education through Technology
More than $700 million available to states and schools in 2002.

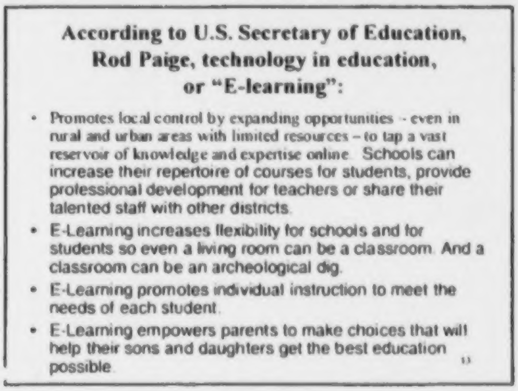
Goals:

- Improve student academic achievement through the use of technology in K-12 schools.
- Ensure that every student is technologically literate by 8th grade.
- Integrate technology resources with teacher training and curriculum development.



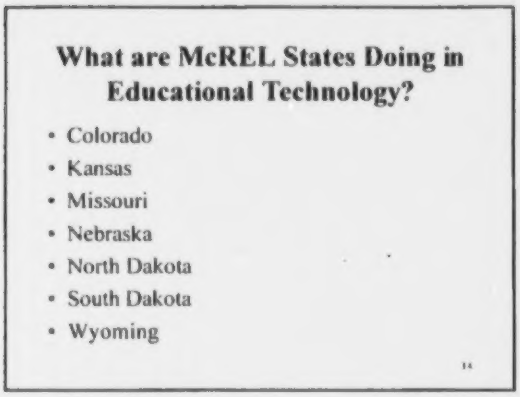
Purposes:

- Help states and localities implement a comprehensive system to effectively use technology in schools.
- Encourage initiatives that will increase access to technology, including those involving public-private partnerships.
- Support an educational technology infrastructure.
- Assist teachers, principals, and administrators with the ability to infuse technology into the curriculum and instruction, including professional development.
- Provide constant access to training and updated research in teaching and learning through electronic means.
- Support electronic networks, such as online learning, of rigorous academic courses and curricula for rural or isolated areas.
- Use technology to promote parental involvement in education and communication with school officials.



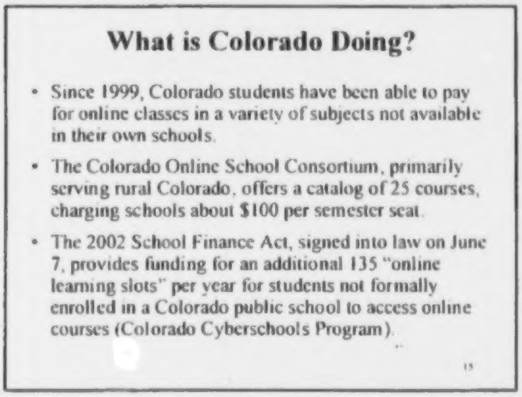
According to U.S. Secretary of Education, Rod Paige, technology in education, or "E-learning":

- Promotes local control by expanding opportunities – even in rural and urban areas with limited resources – to tap a vast reservoir of knowledge and expertise online. Schools can increase their repertoire of courses for students, provide professional development for teachers or share their talented staff with other districts.
- E-Learning increases flexibility for schools and for students so even a living room can be a classroom. And a classroom can be an archeological dig.
- E-Learning promotes individual instruction to meet the needs of each student.
- E-Learning empowers parents to make choices that will help their sons and daughters get the best education possible.



What are McREL States Doing in Educational Technology?

- Colorado
- Kansas
- Missouri
- Nebraska
- North Dakota
- South Dakota
- Wyoming



What is Colorado Doing?

- Since 1999, Colorado students have been able to pay for online classes in a variety of subjects not available in their own schools.
- The Colorado Online School Consortium, primarily serving rural Colorado, offers a catalog of 25 courses, charging schools about $100 per semester seat.
- The 2002 School Finance Act, signed into law on June 7, provides funding for an additional 135 "online learning slots" per year for students not formally enrolled in a Colorado public school to access online courses (Colorado Cyberschools Program).

Colorado

Statistical & Contact Information

Pre-K-12 Enrollment: 725,000

Number of Public School Teachers: 42,000

Students per Network-Connected Computer: 5.8

Students per Internet-Connected Computer: 6.7

E-rate Funding (Through March 15, 2002): $59,032,000

State Education Agency Technology Contact:
Eric Feder
(303) 866-6859
Feder_e@cde.state.co.us

State Education Agency Web Site:
www.cde.state.co.us/index_home.htm

What is Kansas Doing?

- KAN-ED extends interactive distance learning to all school districts. The state legislature this year passed funding for KAN-ED for a 3 year period.
- KAL-TECH, the Kansas Academy for Leadership in Technology, will conduct six "academies" for teaching superintendents and principals how to use technology to effectively improve their schools. This initiative is funded primarily by the Bill & Melinda Gates Foundation.

- One of Kansas' key accomplishments in educational technology is the creation of the state-sponsored instructional-support website.
- The website will offer materials to help teachers teach to the standards (the site will officially be unveiled by the 2002-03 school year).
- The website will give teachers access to model lesson plans, sample assessments, and teaching strategies, among others - all of them to be linked to the state's academic standards.
- Kansas has designed programs to deliver teaching or curriculum via technology.

Kansas

Statistical & Contact Information

Pre-K-12 Enrollment: 470,000

Number of Public School Teachers: 33,000

Students per Network-Connected Computer: 3.7

Students per Internet-Connected Computer: 5.1

E-rate Funding (Through March 15, 2002): $45,851,600

State Education Agency Technology Contact:
Hal Gardner
(785) 296-3202
Hgardner@ksde.org

State Education Agency Web Site:
www.ksbe.state.ks.us/Welcome.htm

What is Missouri Doing?

- MOREnet, Missouri's state education network, provides classrooms with high-speed Internet connections, computers for students, and training and technical support to K-12 schools.
- eMINTS supports educators as they integrate technology in the classroom.
- The state has increased distance-learning opportunities for students and has incorporated technology into state standards.
- University of Missouri-Columbia has a "virtual school" that serves students in middle school and high school.
- Southwest Missouri State University is host to "eHigh School."

Missouri

Statistical & Contact Information

Pre-K-12 Enrollment: 897,000

Number of Public School Teachers: 64,000

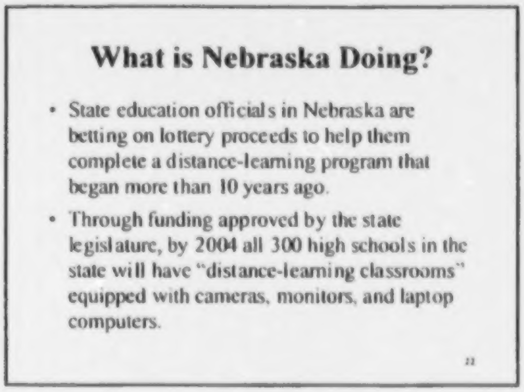
Students per Network-Connected Computer: 4.5

Students per Internet-Connected Computer: 5.8

E-rate Funding (Through March 15, 2002): $160,772,500

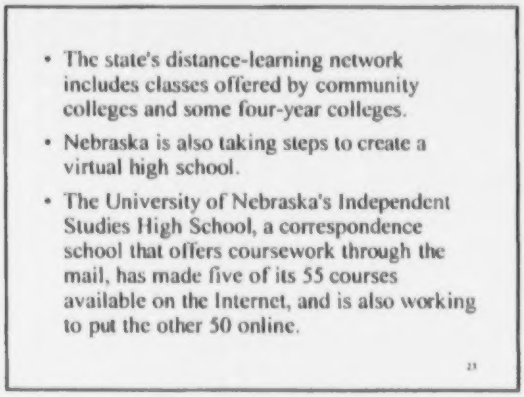
State Education Agency Technology Contact:
Deborah Sutton
(573) 751-8247
Dsutton@mail.dese.state.mo.us

State Education Agency Web Site:
www.dese.state.mo.us

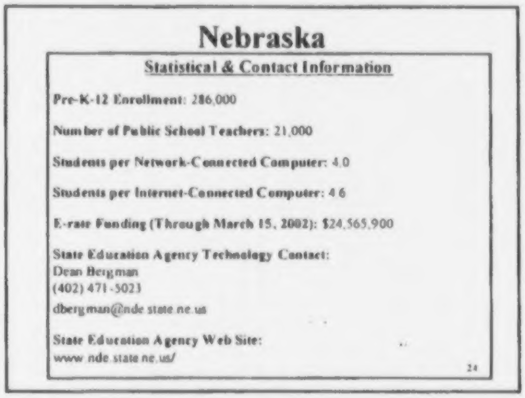


What is Nebraska Doing?

- State education officials in Nebraska are betting on lottery proceeds to help them complete a distance-learning program that began more than 10 years ago.
- Through funding approved by the state legislature, by 2004 all 300 high schools in the state will have "distance-learning classrooms" equipped with cameras, monitors, and laptop computers.



- The state's distance-learning network includes classes offered by community colleges and some four-year colleges.
- Nebraska is also taking steps to create a virtual high school.
- The University of Nebraska's Independent Studies High School, a correspondence school that offers coursework through the mail, has made five of its 55 courses available on the Internet, and is also working to put the other 50 online.



Nebraska

Statistical & Contact Information

Pre-K-12 Enrollment: 286,000

Number of Public School Teachers: 21,000

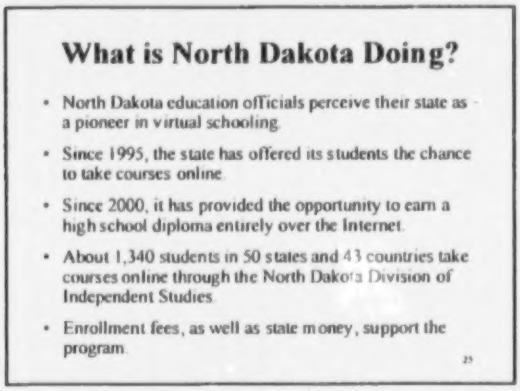
Students per Network-Connected Computer: 4.0

Students per Internet-Connected Computer: 4.6

E-rate Funding (Through March 15, 2002): $24,565,900

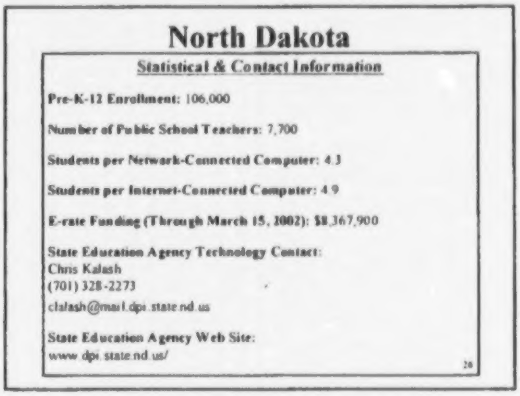
State Education Agency Technology Contact:
Dean Bergman
(402) 471-5023
dbergman@nde.state.ne.us

State Education Agency Web Site:
www.nde.state.ne.us/



What is North Dakota Doing?

- North Dakota education officials perceive their state as a pioneer in virtual schooling.
- Since 1995, the state has offered its students the chance to take courses online.
- Since 2000, it has provided the opportunity to earn a high school diploma entirely over the Internet.
- About 1,340 students in 50 states and 43 countries take courses online through the North Dakota Division of Independent Studies.
- Enrollment fees, as well as state money, support the program.



North Dakota

Statistical & Contact Information

Pre-K-12 Enrollment: 106,000

Number of Public School Teachers: 7,700

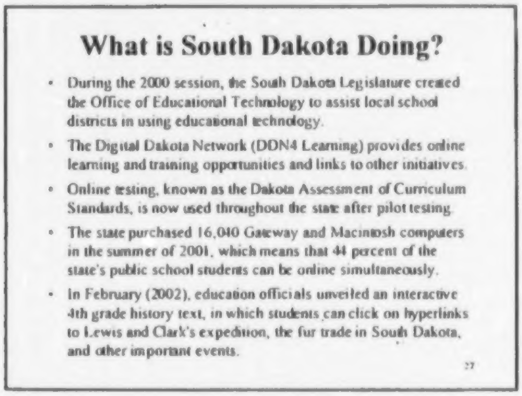
Students per Network-Connected Computer: 4.3

Students per Internet-Connected Computer: 4.9

E-rate Funding (Through March 15, 2002): $8,367,900

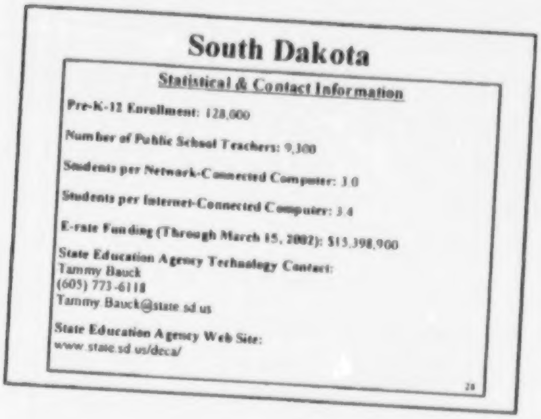
State Education Agency Technology Contact:
Chris Kalash
(701) 328-2273
clalash@mail.dpi.state.nd.us

State Education Agency Web Site:
www.dpi.state.nd.us/



What is South Dakota Doing?

- During the 2000 session, the South Dakota Legislature created the Office of Educational Technology to assist local school districts in using educational technology.
- The Digital Dakota Network (DDN4 Learning) provides online learning and training opportunities and links to other initiatives.
- Online testing, known as the Dakota Assessment of Curriculum Standards, is now used throughout the state after pilot testing.
- The state purchased 16,040 Gateway and Macintosh computers in the summer of 2001, which means that 44 percent of the state's public school students can be online simultaneously.
- In February (2002), education officials unveiled an interactive 4th grade history text, in which students can click on hyperlinks to Lewis and Clark's expedition, the fur trade in South Dakota, and other important events.



South Dakota

Statistical & Contact Information

Pre-K-12 Enrollment: 128,000

Number of Public School Teachers: 9,300

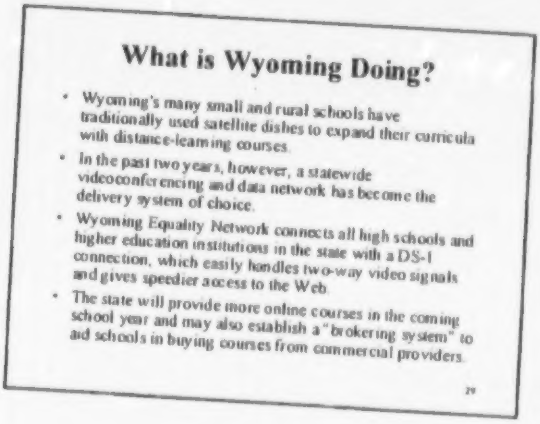
Students per Network-Connected Computer: 3.0

Students per Internet-Connected Computer: 3.4

E-rate Funding (Through March 15, 2002): $15,398,900

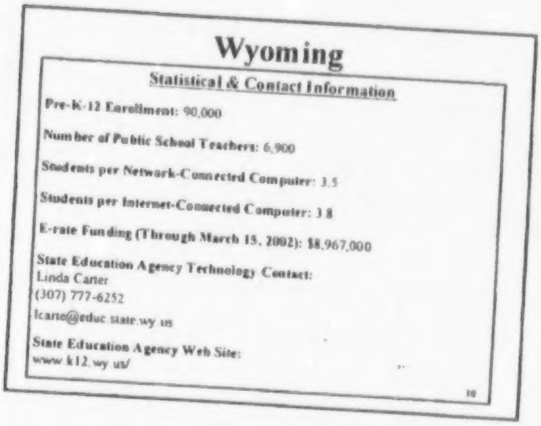
State Education Agency Technology Contact:
Tammy Bauck
(605) 773-6118
Tammy.Bauck@state.sd.us

State Education Agency Web Site:
www.state.sd.us/deca/



What is Wyoming Doing?

- Wyoming's many small and rural schools have traditionally used satellite dishes to expand their curricula with distance-learning courses.
- In the past two years, however, a statewide videoconferencing and data network has become the delivery system of choice.
- Wyoming Equality Network connects all high schools and higher education institutions in the state with a DS-1 connection, which easily handles two-way video signals and gives speedier access to the Web.
- The state will provide more online courses in the coming school year and may also establish a "brokering system" to aid schools in buying courses from commercial providers.



Wyoming

Statistical & Contact Information

Pre-K-12 Enrollment: 90,000

Number of Public School Teachers: 6,900

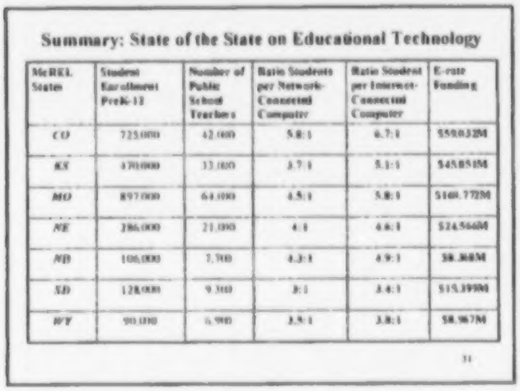
Students per Network-Connected Computer: 3.5

Students per Internet-Connected Computer: 3.8

E-rate Funding (Through March 15, 2002): $8,967,000

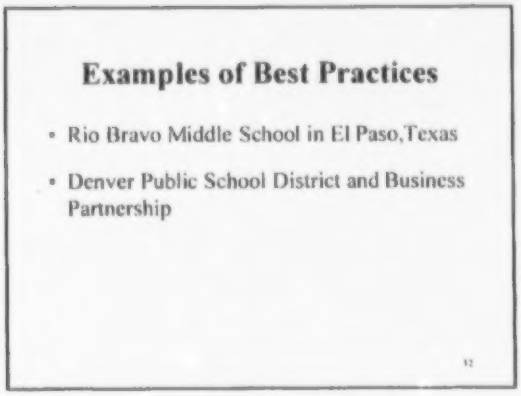
State Education Agency Technology Contact:
Linda Carter
(307) 777-6252
lcarte@educ.state.wy.us

State Education Agency Web Site:
www.k12.wy.us/



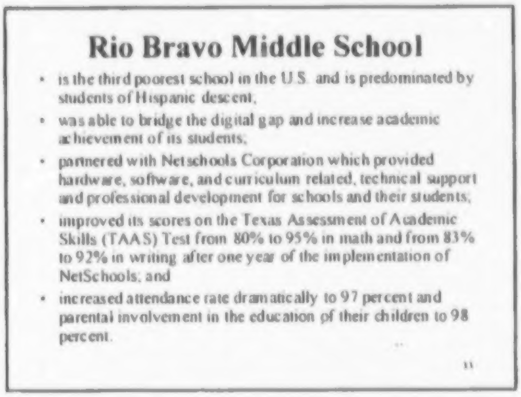
Summary: State of the State on Educational Technology

McREL States	Student Enrollment PreK-12	Number of Public School Teachers	Ratio Students per Network-Connected Computer	Ratio Student per Internet-Connected Computer	E-rate Funding
CO	725,000	42,000	5.8:1	6.7:1	$59.032M
KS	470,000	33,000	3.7:1	5.1:1	$45.851M
MO	897,000	64,000	4.5:1	5.8:1	$169.772M
NE	286,000	21,000	4:1	4.6:1	$24.564M
ND	106,000	7,700	4.3:1	4.9:1	$8.808M
SD	128,000	9,300	3:1	3.4:1	$15.399M
WY	90,000	6,900	3.5:1	3.8:1	$8.967M



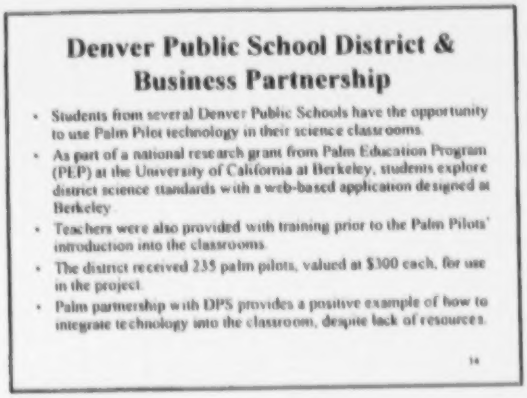
Examples of Best Practices

- Rio Bravo Middle School in El Paso,Texas
- Denver Public School District and Business Partnership



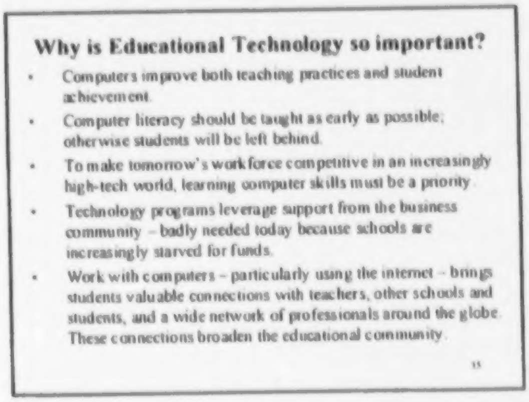
Rio Bravo Middle School

- is the third poorest school in the U.S. and is predominated by students of Hispanic descent;
- was able to bridge the digital gap and increase academic achievement of its students;
- partnered with Netschools Corporation which provided hardware, software, and curriculum related, technical support and professional development for schools and their students;
- improved its scores on the Texas Assessment of Academic Skills (TAAS) Test from 80% to 95% in math and from 83% to 92% in writing after one year of the implementation of NetSchools; and
- increased attendance rate dramatically to 97 percent and parental involvement in the education of their children to 98 percent.



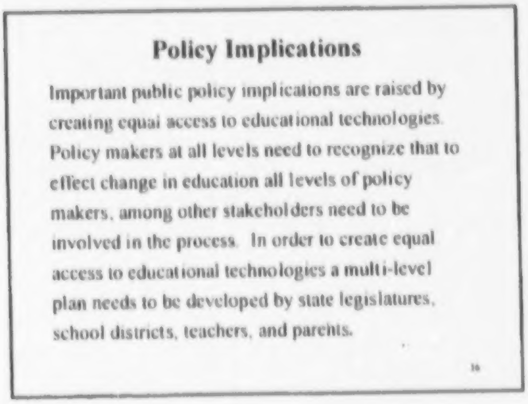
Denver Public School District & Business Partnership

- Students from several Denver Public Schools have the opportunity to use Palm Pilot technology in their science classrooms.
- As part of a national research grant from Palm Education Program (PEP) at the University of California at Berkeley, students explore district science standards with a web-based application designed at Berkeley.
- Teachers were also provided with training prior to the Palm Pilots' introduction into the classrooms.
- The district received 235 palm pilots, valued at $300 each, for use in the project.
- Palm partnership with DPS provides a positive example of how to integrate technology into the classroom, despite lack of resources.



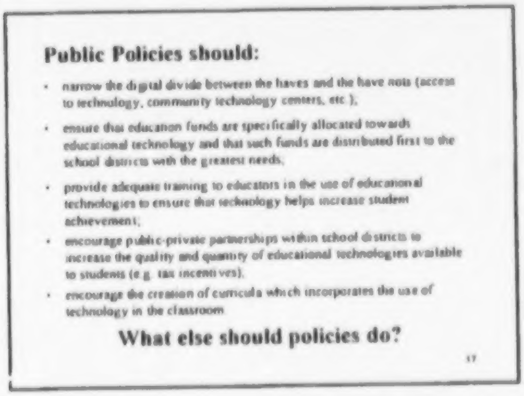
Why is Educational Technology so important?

- Computers improve both teaching practices and student achievement.
- Computer literacy should be taught as early as possible; otherwise students will be left behind.
- To make tomorrow's workforce competitive in an increasingly high-tech world, learning computer skills must be a priority.
- Technology programs leverage support from the business community – badly needed today because schools are increasingly starved for funds.
- Work with computers – particularly using the internet – brings students valuable connections with teachers, other schools and students, and a wide network of professionals around the globe. These connections broaden the educational community.



Policy Implications

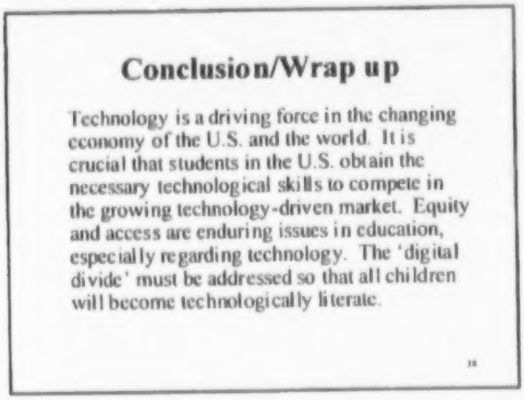
Important public policy implications are raised by creating equal access to educational technologies. Policy makers at all levels need to recognize that to effect change in education all levels of policy makers, among other stakeholders need to be involved in the process. In order to create equal access to educational technologies a multi-level plan needs to be developed by state legislatures, school districts, teachers, and parents.



Public Policies should:

- narrow the digital divide between the haves and the have nots (access to technology, community technology centers, etc.);
- ensure that education funds are specifically allocated towards educational technology and that such funds are distributed first to the school districts with the greatest needs;
- provide adequate training to educators in the use of educational technologies to ensure that technology helps increase student achievement;
- encourage public-private partnerships within school districts to increase the quality and quantity of educational technologies available to students (e.g. tax incentives);
- encourage the creation of curricula which incorporates the use of technology in the classroom

What else should policies do?



Conclusion/Wrap up

Technology is a driving force in the changing economy of the U.S. and the world. It is crucial that students in the U.S. obtain the necessary technological skills to compete in the growing technology-driven market. Equity and access are enduring issues in education, especially regarding technology. The 'digital divide' must be addressed so that all children will become technologically literate.

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Rural Technology Institute 2002

McREL
2550 S. Parker Rd., Suite 500
Aurora, CO 80014

Tips on Writing Your State Legislator and or Member of Congress[1]

A letter is the most popular choice of communication with a legislator and or congressional office. Should you decide to write a letter, this list of helpful suggestions will improve its effectiveness:

1. Your purpose for writing should be stated in the first paragraph of the letter. If your letter pertains to a specific piece of legislation, identify it accordingly, e.g., House Bill: H.R. _____.
2. Be courteous, to the point, and include key information, using examples to support your position.
3. Address only one issue in each letter; and, if possible, keep the letter to one page.

Addressing Correspondence

To a Senator:

The Honorable (full name)
__(Rm.#)__(name of Senate Office Building)
United States Senate
Washington, DC 20510

Dear Senator (last name):

To a Representative:

The Honorable (full name)
__(Rm.#)__(name of House Office Building)
United States House of Representatives
Washington, DC 20515

To the Chair of a Committee:

Dear Mr. Chairman or Madam Chairwoman:

To the Speaker of the House:

Dear Mr. Speaker:

To a State Legislator (Senate):

The Honorable (full name)
(the state) State Senator, District __
(street address), (Rm.#)__
[city, state, zip code]

To a State Legislator (House):

The Honorable (full name)
(the state) State Representative, District __
(street address), (Rm.#)__
[city, state, zip code]

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[1] Adapted from the National Education Knowledge and Industry Association's Tips on Writing Your Member of Congress. http://www.nekia.org/

Tips on E-mailing Congress or State Legislator

The same guidelines apply as with writing letters to Congress and State legislature. The easiest way to locate your Representative's email address is via the House web site at www.house.gov and the Senate web site at www.senate.gov. Additionally, here are the following websites that will aid you in getting in touch with the Members of your state Legislature via email.

Colorado

House - http://www.state.co.us/gov_dir/leg_dir/house/members/index.htm
Senate - http://www.state.co.us/gov_dir/leg_dir/senate/members/index.htm

Kansas

House - http://www.accesskansas.org/legislative/houseroster/index.html
Senate - http://www.accesskansas.org/legislative/senateroster/index.html

Missouri

House - http://www.house.state.mo.us/bills02/member02/memmail.htm
Senate - http://www.senate.state.mo.us/senalpha.htm

Nebraska[2]

Senate - http://www.unicam.state.ne.us/senators/senators.htm

North Dakota

House - http://www.state.nd.us/lr/assembly/57-2001/house/members/name-roster.html
Senate - http://www.state.nd.us/lr/assembly/57-2001/senate/members/names-roster.html

South Dakota

House - http://legis.state.sd.us/general/index.cfm?FuseAction=DistrictListing
Senate - http://legis.state.sd.us/general/index.cfm?FuseAction=DistrictListing

Wyoming

House - http://legisweb.state.wy.us/2002/members/rep.htm
Senate - http://legisweb.state.wy.us/2002/members/sen.htm

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[2] Nebraska only has a single-house system.

Members of Congress – Colorado

U.S. House of Representatives		*U.S. Senate*
District	**Name & Contact Information**	**Name & Contact Information**
01	**Diana DeGette** 1530 Longworth HOB United States House of Representatives Washington, DC 20515-0601 Phone: (202) 225-4431	**Wayne Allard** 525 Dirksen Senate Office Bldg. United States Senate Washington , D.C. 20510 Phone: (202) 224-5941
02	**Mark Udall** 115 Cannon HOB United States House of Representatives Washington, DC 20515-0602 Phone: (202) 225-2161	**Ben Nighthorse Campbell** 380 Russell Senate Office Bldg. United States Senate Washington, DC 20510 Phone: (202) 224-5852
03	**Scott McInnis** 320 Cannon HOB United States House of Representatives Washington, DC 20515-0603 Phone: (202) 225-4761	
04	**Bob Schaffer** 212 Cannon HOB United States House of Representatives Washington, DC 20515-0604 Phone: (202) 225-4676	
05	**Joel Hefley** 2230 Rayburn HOB United States House of Representatives Washington, DC 20515-0605 Phone: (202) 225-4422	
06	**Thomas G. Tancredo** 418 Cannon HOB United States House of Representatives Washington, DC 20515-0606 Phone: (202) 225-7882	

Members of Congress - Kansas

U.S. House of Representatives		*U.S. Senate*
District	**Name & Contact Information**	**Name & Contact Information**
01	**Jerry Moran** 1519 Longworth HOB United States House of Representatives Washington, DC 20515-1601 Phone: (202) 225-2715	**Sam Brownback** 303 Hart Senate Office Bldg. United States Senate Washington, D.C. 20510 Phone: (202) 224-6521
02	**Jim Ryun** 330 Cannon HOB United States House of Representatives Washington, DC 20515-1602 Phone: (202) 225-6601	**Pat Roberts** 302 Hart Senate Office Building United States Senate Washington, D.C. 20510 Phone: (202) 224-4774
03	**Dennis Moore** 431 Cannon HOB United States House of Representatives Washington, DC 20515-1603 Phone: (202) 225-2865	
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Members of Congress - Missouri

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Members of Congress - Missouri

U.S. House of Representatives		*U.S. Senate*
District	**Name & Contact Information**	**Name & Contact Information**
03	**Richard A. Gephardt** 1236 Longworth HOB United States House of Representatives Washington, DC 20515-2503 Phone: (202) 225-2671	
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05	**Karen McCarthy** 1330 Longworth HOB United States House of Representatives Washington, DC 20515-2505 Phone: (202) 225-4535	
06	**Sam Graves** 1407 Longworth HOB United States House of Representatives Washington, DC 20515-2506 Phone: (202) 225-7041	
07	**Roy Blunt** 217 Cannon HOB United States House of Representatives Washington, DC 20515-2507 Phone: (202) 225-6536	
08	**Jo Ann Emerson** 326 Cannon HOB United States House of Representatives Washington, DC 20515-2508 Phone: (202) 225-4404	
09	**Kenny C. Hulshof** 412 Cannon HOB United States House of Representatives Washington, DC 20515-2509 Phone: (202) 225-2956	

Members of Congress – Nebraska

	U.S. House of Representatives	*U.S. Senate*
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02	**Lee Terry** 1513 Longworth HOB Washington, DC 20515-2702 United States House of Representatives Phone: (202) 225-4155	**Ben Nelson** 720 Hart Senate Office Building United States Senate Washington, DC 20510 Phone: (202) 224-6551
03	**Tom Osborne** 507 Cannon HOB United States House of Representatives Washington, DC 20515-2703 Phone: (202) 225-6435	

Members of Congress – North Dakota

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		Kent Conrad 530 Hart Senate Office Building United States Senate Washington, DC 20510-3403 Phone: (202) 224-2043

Members of Congress – South Dakota

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		Tim Johnson 324 Hart Senate Office Building United States Senate Washington, DC 20510 Phone (202) 224-5842

Members of Congress – Wyoming

U.S. House of Representatives		*U.S. Senate*
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		Craig Thomas 109 Hart Senate Office Bldg. United States Senate Washington, DC 20510 Phone: (202) 224-6441

Rural Technology Institute 2002
Educational Technology and Policy

The Education World: The Educator's Best Friend
http://www.education-world.com/

e-Schools News online – where K-12 Education and Technology meet
www.eschoolnews.org

Information from the FCC on CIPA Order Reflecting Recent Court Decision
http://www.sl.universalservice.org/

Information from the FCC on Unused E-Rate Funds
http://hraunfoss.fcc.gov/edocs_public/attachmatch/DOC-223394A4.doc

Netschools
http://netschools.com/

Review of Community Technology Centers
http://glef.org/ctc/html

States
Colorado Plan for Educational Technology and Information Literacy
http://www.cde.state.co.us/cdetech/download/pdf/et_state-plan.pdf

Kansas Technology Plan
http://www.taken.org/

Missouri – Education Technology Strategic Plan: 2002-2006
http://www.dese.state.mo.us/divimprove/instrtech/techplan/02-06statetechplan.pdf

North Dakota State Education Technology Plan for 2001-03
http://www.dpi.state.nd.us/news/archive/062801.shtm

South Dakota Tech Prep Strategic Plan 2002
http://www.state.sd.us/deca/oldweb/workforce/services/techprep/documents/TECH%20PREP%20STRATEGIC%20PLAN%202002.doc

Wyoming Transitional State Plan
http://www.k12.wy.us/publications/stateplan.html
To see the Tech Prep Section - http://www.k12.wy.us/publications/stateplan.html#techprep

Summary of New E-Rate Processes
http://www.sl.universalservice.org/data/pdf/ERATE_DISCOUNTS_FOR_SCHOOLS_&_LIBRARIES.pdf

Technology Briefs for "No Child Left Behind" Planners
http://www.neirtec.org/products/techbriefs/default.asp

University of Colorado at Denver – Web Resource Collaboration Center
http://carbon.cudenver.edu/public/wle/wrcc/edli7710/

Notes

Curriculum Unit Design

Kathy Brabec, McREL
Monday, July 29, 2002

GOOD TECHNOLOGY AND GOOD PRACTICES

Overview of a Science Unit

BIOMES

Beginning of Unit

- KWL chart
- Instructional strategy – Representing knowledge
- General Biome Notes
- Instructional strategy – note taking and knowing similarities and differences

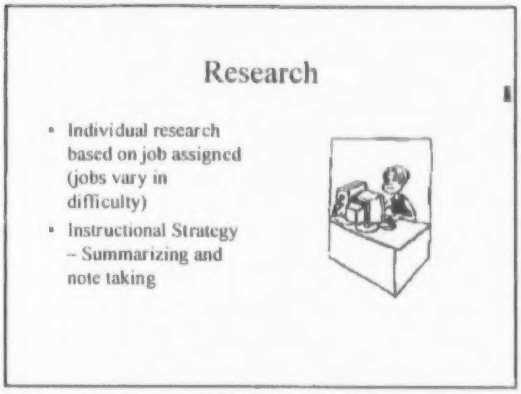
Beginning of Web Quest: BioQuest

Whole Group Introduction

- Show log-in procedure
- Read Introduction together
- Read standards together
- Instructional Strategies – Setting of objectives

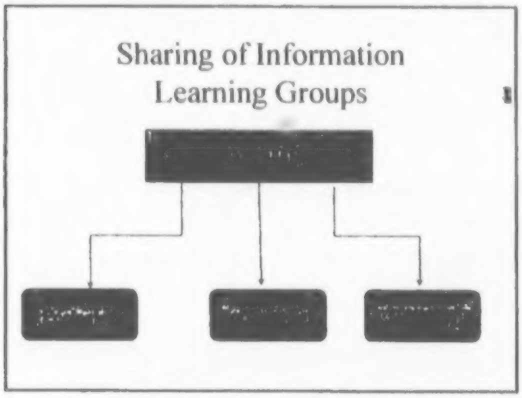
Log on to BioQuest to see instructional standards and goals:

http://summit.k12.co.us/schools/SMS/kirkland/biomequest/

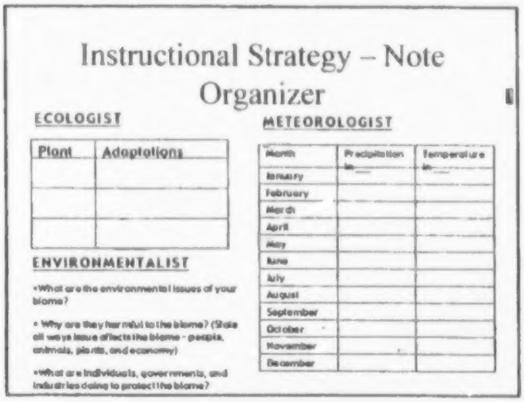


Research

- Individual research based on job assigned (jobs vary in difficulty)
- Instructional Strategy
  - Summarizing and note taking



Sharing of Information Learning Groups



Instructional Strategy – Note Organizer

ECOLOGIST

Plant	Adaptations

ENVIRONMENTALIST

- What are the environmental issues of your biome?
- Why are they harmful to the biome? (State all ways issue affects the biome - people, animals, plants, and economy)
- What are individuals, governments, and industries doing to protect the biome?

METEOROLOGIST

Month	Precipitation in ___	Temperature in ___
January		
February		
March		
April		
May		
June		
July		
August		
September		
October		
November		
December		

END OF UNIT ASSESSMENT BIOME BROCHURE

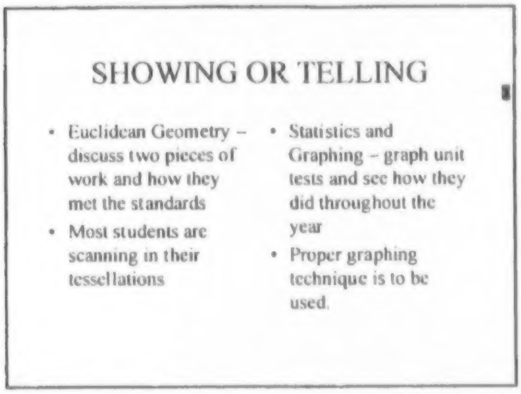
·Rubric given to students
·Information from all 3 jobs is included in the brochure
·Samples are show to students
·Instructional strategy - representing knowledge

ELECTRONIC MATH PORTFOLIO

- Students create a math portfolio to include reflection on each major unit
- Students always reflect on the unit as a whole
- Students add another piece of work from each unit
- Flow chart, digital picture, and scanned image are to be included

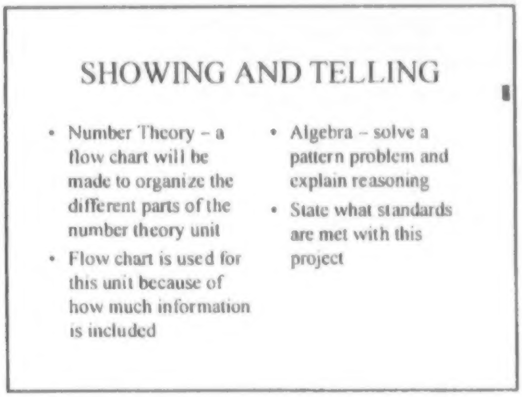
END OF UNIT REFLECTIONS

- Students will reflect on the unit as a whole at the end of each major unit.
- Reflections will name the unit, state strengths and weaknesses, state what was understood, and what they would like to have studied more in depth



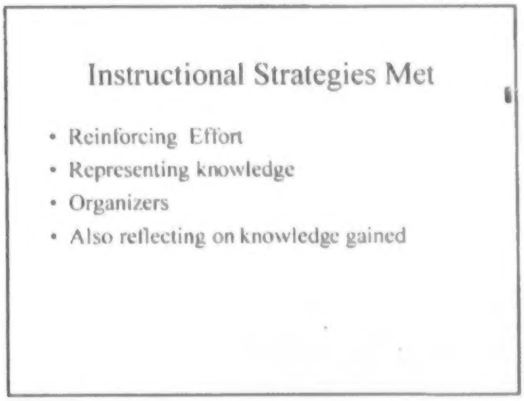
SHOWING OR TELLING

- Euclidean Geometry – discuss two pieces of work and how they met the standards
- Most students are scanning in their tessellations
- Statistics and Graphing – graph unit tests and see how they did throughout the year
- Proper graphing technique is to be used.



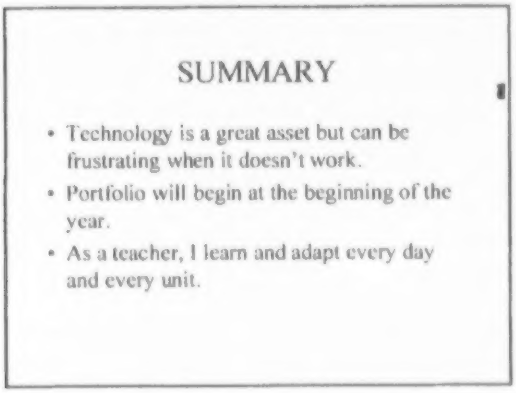
SHOWING AND TELLING

- Number Theory – a flow chart will be made to organize the different parts of the number theory unit
- Flow chart is used for this unit because of how much information is included
- Algebra – solve a pattern problem and explain reasoning
- State what standards are met with this project



Instructional Strategies Met

- Reinforcing Effort
- Representing knowledge
- Organizers
- Also reflecting on knowledge gained



SUMMARY

- Technology is a great asset but can be frustrating when it doesn't work.
- Portfolio will begin at the beginning of the year.
- As a teacher, I learn and adapt every day and every unit.

Web Sites Mentioned in the Presentation

Great Teacher Web Sites
http://www.mcrel.org/products/tech/websites.asp

High Plains Regional Technology in Education Consortium (HPRTEC)
http://hprtec.org/

Biome WebQuest
http://summit.k12.co.us/schools/SMS/kirkland/biomequest /

Free Inspiration and Kidspiration 30 day downloads
www.inspiration.com

Curriculum Unit Design Model

Instructional Technique Identified by Research	What technology tools could be used to support this strategy?
At the beginning of a lesson: • Identify a clear learning goal for the lesson.	PowerPoint lesson or unit introduction Power Point presentation showing an example of a good piece of work WebQuest
• Communicate the learning goals to students and to parents.	A web page that the parents and students could access from home. A digital photo of past work. More frequent communication via email.
• Have students identify and record their own learning goals.	Have students type their goals in a word processor. Show their progress through a series of photos (slideshow) or a short film. KWHL graphic organizer
• Instill positive beliefs about the importance of and purpose for the learning goals; counteract any negative student self-talk.	Relating the goals to real life by modeling, showing web examples that anchor learning to real circumstances. Activities that use real data
During the lesson: • Have students design strategies to accomplish their learning goals.	Inspiration software – webbing, outlines, mapping. Hyperstudio or PowerPoint or Kid Picks for presentation.
• Have students monitor their progress toward accomplishing the learning goals.	Develop checklist or graphs on Excel. Peer editing. Rubrics designed by students. Time management chart. Teacher interaction. Journaling. Portfolio entries.
• Give students explicit and precise feedback on how well they are meeting their learning goals.	Completion of checklists and rubrics. Student/teacher conferencing.

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Curriculum Unit Design Model

Instructional Technique Identified by Research	How could technology tools be used to support this strategy?
When addressing new knowledge: • Have students identify what they already know about the topic.	Inspiration- KWL chart Share websites they already are familiar with. Journaling, graphic organizers.
• Have students compare and contrast new knowledge with what they already know.	Simulation software: cause and effect analysis Inspiration
• Have students keep a record of the knowledge they gain.	Hotlist/Favorites/Bookmarks Word Processing Document- copy and paste addresses, type notes Email correspondence
• Have students represent their knowledge in linguistic (notes, papers, outlines) and nonlinguistic (pictures, charts, semantic maps) ways.	Digital cameras, video, webbings, PowerPoint, Hyperstudio, KidPix etc. Graphic organizers
• Provide students with ways of thinking about the topic in advance (cues, questions, advance organizers).	Inspiration, Internet scavenger hunt, PowerPoint overvies
• Have students occasionally work in cooperative groups.	Simulation software, WebQuests, Email
When knowledge is being reviewed or applied: • Have students revise previous work to practice and apply their new knowledge.	Basic Office suite programs lend themselves to practice and revision exercises. Web sites with practice exercises. Production projects such as travel brochures, art, poetry, web sites etc.
• Engage students in experimental inquiry, problem-solving, decision-making, and investigation situations.	WebQuest Design experiments to answer remaining questions and then use technology to present a summary of findings to peers and teachers.
• Have students make and test predictions.	Data gathering and summation using graphing and database programs.

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Curriculum Unit Design Model

Instructional Technique Identified by Research	How could technology tools be used to support this strategy?
At the end of a unit: • Provide a clear assessment for each learning goal.	Basic application software, test generation software, online assessments, internet based assessments, multimedia presentation. Rubric generators like RubiStar.
• Have students assess themselves and compare these assessments with those of the teacher.	Online assessments, using collaboration tools to provide cooperative assessments. RubiStar
• Have students articulate what they have learned about the content and about themselves as learners.	Word processors, graphing, multimedia software, reflective journaling, visualizations using applications within community.

Based on the work reported in Robert J. Marzano and John S. Kendall, "A Theory-Based Meta-Analysis of Research on Instruction," McREL (December 1998): 128–136 and Robert Marzano, Jo Sue Whisler, Ceri B. Dean, and Janie Pollock, "Research into Practice: Effective Instructional Practices in the Classroom," McREL (September 2000).

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Technology Proficiencies and Unit Planning

Curriculum Unit Design Model

Lesson plan idea for ______________________
(topic)

Instructional Technique Identified by Research	Lesson Plan Strategy	How could technology tools be used to support this strategy?
At the beginning of a lesson: • Identify a clear learning goal for the lesson.		
• Communicate the learning goals to students and to parents.		
• Have students identify and record their own learning goals.		
• Instill positive beliefs about the importance of and purpose for the learning goals; counteract any negative student self-talk.		
During the lesson: • Have students design strategies to accomplish their learning goals.		
• Have students monitor their progress toward accomplishing the learning goals.		
• Give students explicit and precise feedback on how well they are meeting their learning goals.		

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Instructional Technique Identified by Research	Lesson Plan Strategy	How could technology tools be used to support this strategy?
When addressing new knowledge: • Have students identify what they already know about the topic.		
• Have students compare and contrast new knowledge with what they already know.		
• Have students keep a record of the knowledge they gain.		
• Have students represent their knowledge in linguistic (notes, papers, outlines) and nonlinguistic (pictures, charts, semantic maps) ways.		
• Provide students with ways of thinking about the topic in advance (cues, questions, advance organizers).		
• Have students occasionally work in cooperative groups.		
When knowledge is being reviewed or applied: • Have students revise previous work to practice and apply their new knowledge.		
• Engage students in experimental inquiry, problem-solving, decision-making, and investigation situations.		
• Have students make and test predictions.		

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Instructional Technique Identified by Research	Lesson Plan Strategy	How could technology tools be used to support this strategy?
At the end of a unit: • Provide a clear assessment for each learning goal.		
• Have students assess themselves and compare these assessments with those of the teacher.		
• Have students articulate what they have learned about the content and about themselves as learners.		

Based on the work reported in Robert J. Marzano and John S. Kendall, "A Theory-Based Meta-Analysis of Research on Instruction," McREL (December 1998): 128–136 and Robert Marzano, Jo Sue Whisler, Ceri B. Dean, and Janie Pollock, "Research into Practice: Effective Instructional Practices in the Classroom," McREL (September 2000).

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Building a Technology Integrated Unit
TIE 2002

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References and Resources

From ASCD
Classroom Instruction That Works: Research-Based Strategies for Increasing Student Achievement 2001
by Robert J. Marzano, Debra J. Pickering, and Jane E. Pollock
ISBN: 0-87120-504-1
http://shop.ascd.org/ProductDisplay.cfm?ProductID=101010
ASCD member price: $20.95

A Handbook for Classroom Instruction that Works 2001
Robert J. Marzano
ISBN: 0-87120-522-X
http://shop.ascd.org/ProductDisplay.cfm?ProductID=101041
ASCD member price: $26.95

From McREL
A Theory-Based Meta-Analysis of Research on Instruction 1998
by Robert J. Marzano
Free PDF
http://www.mcrel.org/products/learning/meta.asp

What Works in Classroom Instruction 2000
by Robert J. Marzano, Barbara B. Gaddy and Ceri Dean
Free PDF
http://www.mcrel.org/products/learning/whatworks.pdf

Research Into Practice Series: Effective Instructional Practices 2000
Bound Participant's Manual $18.75
Facilitator's Kit $79.95
http://www.mcrel.org/resources/services/rips.asp

Curriculum Unit Design Model
Free PDF
http://www.mcrel.org/products/tech/facilitator.asp

Additional Web Resources for Teachers

Quia

http://www.quia.com/

You can use teacher-created games and quizzes for FREE. To create materials, there is a $49/year subscription fee. Students can take the quizzes online and you will get a report of their progress. From the main page, go to Quia Web to browse the activities available.

Noodle Tools Quick Cite

http://www.noodletools.com/quickcite/

A quick and dirty place to use for citing resources using MLA style. This is a stripped down version of one of their subscription services, so you need to copy/paste and possibly do some underlining or italics when you paste the citation. All items at Noodle Tools used to be free, but now most are subscription.

Great Teacher Websites

http://www.mcrel.org/products/tech/websites.asp

This is a short list of sites we think offer great starting places for teachers.

John Kuglin's homepage

http://www.kuglin.com/

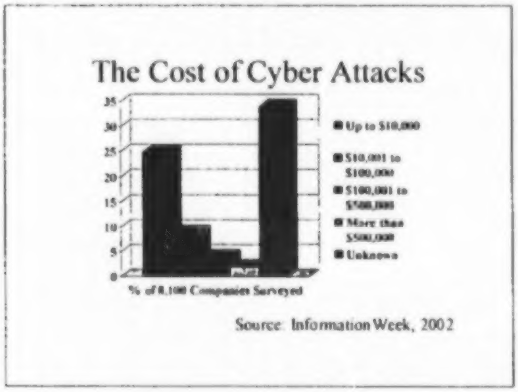
John Kuglin is a national keynote speaker. This page is a great place to discover some cutting edge technology possibilities, though not designed for a classroom teacher looking for specific resources. You might want to start with the **Keynote Web Site Handouts** section.

Notes

Technology Resources

Glen Taylor, McREL
Monday, July 29, 2002

Security Audit - 8 Steps



The Cost of Cyber Attacks

Source: InformationWeek, 2002

Security Incidences Rising

Risk Analysis

- What assets are you trying to protect?
  - Physical and Digital
- What is the value to your school?
- What are the potential threats?
- What is the impact of the potential threats?

Risk Analysis

- Actions
  - Inventory of all assets regularly
  - Create shortlist of key data owners
  - Assess the impact of loss
  - Categorize data on the basis of sensitivity and importance
  - Categorize the threats and rate the actuality of accurance for your situation

Preparation

- Careful planning is a must.
- Prioritize audit targets
- Consider the "angles" of risk for each asset identified.
  - Digital
  - Physical
  - Procedural

Review Policies and Reports

- What are the security goals for your IT installation?
- Who is responsible? - Not just the IT staff!
- State the rules - even the "obvious."
- Map IT.
- What happens in the event of a breach to your security goals?

Gather "People" Information

- Start with yourself and other IT staff.
- Interview users - be sensitive.
- Talk with plant and grounds maintenance employees.

Testing

- Logs - Logs - Logs
- Smoking guns:
  - Apps that run as root
  - Surplus Network Services
  - Remote control/consoles
  - Ports!
- Check permissions periodically
- Physical security often most often neglected

Evaluating Your Data

- Analyze
- Itemize
- Label
- Prioritize Actions
- Plan for Continuous Improvement Procedures
- Estimate Time to get to - Phase 1,2,3...

Reporting Your Findings

- Follow-up with yourself and staff to discuss findings and plan.
- Make copies of test data and secure it.
- Redraft any procedures and/or policies that are lacking.
- Assess your audit tools.

Security Tools

- Firewalls
- Port Scanners
- Sniffers
- Intrusion Detection Systems
- Antivirus
- User Training
- Network Maps
- … and more

Post Audit Actions

Continuity Planning: An IT Decision Guide

INFO-TECH RESEARCH

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Why Should You Care About Disaster Recovery Planning? 4

Disaster Preparedness: Put a Price Tag on Your Data 4

Contingency Planning: A Business Case 6

Business Impact Analysis (BIA) 7

How to Win Executive Support for Your DRP 8

Disaster Planning More Critical than Ever 9

Test Your Disaster Readiness 10

Disaster Recovery: Safe or Sorry? 10

Lessons Learned From The Largest Project In IT History 11

Disaster Planning: Options Analysis 13

The Essential Elements of a Disaster Recovery Plan (DRP) 13

Backup 14

Archiving 16

Electronic Vaulting and Mirroring 17

Recovery Phase Planning 18

Disaster Recovery In A Post 9-11 World 18

Analyze the Potential Impact of Disaster on Your Business 19

Physically Protect Your IT Assets 22

White Paper: Securing Info Assets 22

Physically Protect Your Servers 22

Its Time to Build an Incident Response Team 24

Purchasing and Implementation Issues 27

Prevention vs. Cure: It's Time for Online Backup 27

A Paranoid's Guide to SQL Backups 28

Tips for Safe Data Recovery 29
Should You Outsource Disaster Recovery? 30
Outsourcer Failure: Be Prepared 31
Documentation: Get Up to Speed and Stay There! 32
Your Strategy for Stored Data Recovery 33
Tips for Safe Data Recovery 35
Crisis Management: How to Handle a System Outage 36

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Introduction

Disaster can strike at any time, and in a variety of unexpected ways. Your job as an IT decision maker is to:

- Try to anticipate the myriad forms disaster can take.
- Take preventative and protective action to minimize the negative impact of disaster on your systems.
- Develop and execute streamlined recovery plans to get your business back on its feet faster.

Disaster recovery planning should be at the top of your IT agenda. While the hope is that you'll never have to put the fruits of your labor into action, the consequences of not having a "just-in-case" contingency plan are dire. It could mean the end of your business.

This Decision Guide provides best-of-breed information on disaster recovery and business continuity issues in a comprehensive format. Use it as a primary resource and ongoing reference tool when developing your disaster planning strategy.

Build Your Disaster Planning Case

Why Should You Care About Disaster Recovery Planning?

Disaster Readiness Strategic Planning Guide, 03-Oct-00

Recent research shows that one major barrier to disaster preparedness is lack of senior management support and funding. After all, they seem to think, disaster recovery planning is a complex, time- and resource-consuming process with little obvious benefit. Yet insurance statistics indicate that billions of dollars are lost through catastrophes of one sort or another. Accidents are, by definition, unexpected; however, business managers must realize that when a disaster strikes it is often a matter of life and death for their businesses.

Here are a few reasons why you must plan for disasters:

- **Survivability of your business might depend on it:** Most companies could not stay in business very long without their mission critical applications following a computer system failure. Fast recovery after a disaster or system failure can mean the difference between life and death for your business.
- **Downtime is costly:** A computer system failure, no matter what its gravity, results in increased expenses, lost revenue, and lost customers. A tested business recovery plan ensures faster recovery, and consequently, less downtime.
- **Business delivery deadlines:** If you are a supplier, you must deliver the services or products to the other party no matter what your circumstances, or pay the penalties.
- **Law may require it:** Company officers are legally liable to protect company assets, including electronic data, particularly if you're a public company, a bank, a utility, or a government agency.

Disaster Preparedness: Put a Price Tag on Your Data

Info-Tech Advisor, 02-Oct-01

You need to ramp up your security and disaster preparedness practices, but you have a limited budget. What do you protect and to what degree? Prioritizing which information assets are the most valuable to your business is the first step.

Information Value Facts:

- Information is valuable because it is used to achieve organizational goals.
- Information does not always hold its value over time and rests largely in being relevant and available when decisions need to be made.
- Interfering with information's availability through data corruption, interruption, or sabotage has a massive negative effect on its value.

Action Plan: Given the complexity and lack of hard-and-fast methodologies for valuing information, there are still some steps that will help you decide how to invest in safeguarding your organization's information assets.

Classify Your Data: Information comes from different sources, takes different formats, and is applied in different ways. Some obvious data types are customer information, intellectual property, and personnel records. Talk to different departments to find out what types of data they create and handle. Create a definitive list, and update as needed. See InformationWeek's "Behind the Numbers: Companies Struggle With Data Classification" for more on the role of classification.

1. **Identify What Decisions Matter:** Decision-making is the most significant information-utilizing event. Some decisions are clearly more important than others, and certain types of information will emerge as higher priority than others because of who uses them and their relationship to revenue generation.

    - Ask other managers and executives what their most important ongoing decisions are, as well as what are their secondary and tertiary decision types.

    - Find out what types of information are required to make important decisions. Create a prioritized list.

    - Identify the generation point and storage location of this key information.

2. **Build an Information Map:** Creating a visual model of your organization's information resources helps put the information in a context and build interrelationships between different information types. For example, two different types and levels of information may reside on the same server. This would be important to know when devising a backup strategy.

    - In your map, indicate all of your information holdings. Include identification of all points where information is handled (i.e. created, processed, or destroyed); stored; and who uses it.

3. **Appraise Value:** Under the Generally Accepted Accounting Principles (GAAP), companies cannot show the value of intangible assets, such as information assets, on a balance sheet. Valuing information, therefore, is much like valuing a house - an appraisal method works best. Appraisal techniques that are frequently applied include:

    - ***The Cost Approach:*** Determine how much it would cost to re-create or acquire this information today.

    - ***The Market Comparable Approach:*** Determine the amount the information, or similar information, could be sold for on the market. This works best when a well-established market is already in place.

    - ***The Income Approach:*** Determine what investors are willing to pay to have that information applied in order to meet a given income stream in the future i.e. what increased profit is attributable to the application of the information.

Bottom Line: The ultimate goal of valuing information is to get it included on your company's balance sheet along with other key corporate assets. However, this dream may not become reality for some time to come given current accounting practices. In the meantime, start treating information as an asset and protect it accordingly.

Want to Know More?

- Read Intelligent Enterprise's "Information Impact" and "Information Impact: Business Analytics Revealed (Part 2)" for a breakdown of their DEER methodology for valuing information.
- See Strategic Finance's "Valuing Intangible Assets Through Appraisals."
- Take a look at the UK Library and Information Commission's "Valuing information assets in UK companies" and Unisys Corporation EXEC On-Line Journal's "A Practical Agenda for the Information Age."
- Finally, check out Inforum's "The Relationship Between Knowledge Management and Information Management."

Contingency Planning: A Business Case

Info-Tech Advisor, 21-Aug-01

Would senior management sit-up and listen if they were told that a salesperson lost an order for $100,000 because he could not obtain price quotes due to a downed central mainframe?

Real World Example from ConnectSouth: "We regret to inform you that your Web hosting service with ConnectSouth will cease on or before September 1/2001. ConnectSouth recommends that you follow the process below to change service providers to ensure that you continue the operation and availability of your Web site. Customers will have to choose a new Web hosting service provider, effective immediately." ***Could something like this happen to your department?***

The most difficult task for many organizations is to determine the money and resources necessary to devote towards a corporate data contingency plan. The best way to determine how much to invest in your data contingency plan is to conduct a business analysis using these three criteria:

- Identify the potential risks.
- Estimate the effects of a disaster on the organization.
- Determine the requirements of a recovery strategy.

Action Plan: Once you have determined that you require a data contingency plan, use the following action steps to assist you in getting your new initiative up and running.

1. **Appoint a Data Center Recovery Team:** The "Recovery Team" should be composed of those individuals inside the organization most knowledgeable of the organization's data center operation. It is good practice for larger businesses to include a legal officer, a public relations officer, and a security officer on the Recovery Team.

2. **Build a Data Center Contingency Plan:** This plan should be developed by the Recovery Team and should address as many scenarios as the Recovery Team can contemplate. The Recovery Team should do the following:
   - Assess the adequacy of the organization's current measures and contingency planning for information resources.
   - Provide business-based recommendations for improvements.
3. **Write Data Center Contingency Plan Content:** The contents of the Data Recovery Plan should, at a minimum, address the following:
   - **Initial Damage Assessment:** The Recovery Team will need specific information in an efficient presentation in order to assess the situation. The Plan should define what an emergency event is.
   - **Securing the Subject Site:** The Plan should outline the procedure for gaining control of the hardware, software, and data.

Bottom Line: Not having a contingency plan in place to deal with data recovery could mean big financial losses for your organization. Think ahead and institute a well thought out plan that could rescue you from terrible times.

Want to Know More?

- Start by reading "Data Center Contingency Plans" by The Web Host Industry Review.
- Next, check out "Data Coordination Center for the NIC-DC Initiative to Reduce Infant Mortality in Minority Populations" by the Office of Research on Minority Health. Be sure to examine the bottom half on this document for relevant information.
- Finally, see "Justifying the Contingency Plan" by the Disaster Recovery Journal.

Business Impact Analysis (BIA)

Disaster Readiness Strategic Planning Guide, 03-Oct-00

The conducting of a BIA should ideally be the first phase of disaster recovery planning. The results of BIA are important in gaining senior management support for emergency preparedness. The analysis puts the consequences of disasters and disruptions in financial terms that senior executives understand best.

No organization has the time or the resources to recover every functional area following a major disaster. The fact is that not all systems are absolutely critical. Sheer cost will likely prohibit incorporating each and every system in your DRP.

BIA aims to evaluate the bottom line effect (in dollar terms) of a systems disaster or outage on your business. Each functional area is evaluated to determine the cost to the company for as long as that function is not restored.

A properly conducted BIA should answer critical questions, such as:

- What are the costs in lost revenue, market share, goodwill, and penalties you can expect if your computer system goes down for an hour, a day, or a week?
- How fast do you need to recover without incurring intolerable loss?
- How much data loss can you tolerate? 1 second, an hour, or 24 hours of data?
- How should you prioritize your functional systems during an actual disaster? What must be recovered first, second, and third, and what can wait until later?

Thus a BIA helps you to determine what are known as the "recovery point" and the "recovery time" for each of your functional systems.

- **Recovery Point** refers to the amount of acceptable information loss in the event of computer system failure. A recent recovery point is most important in data-centric operations where the loss of data is unacceptable, such as back office applications like inventory management, general ledger accounting or payroll. Such operations can withstand some downtime; however, when the interruption is concluded the data had better not be lost. Activity must pick up from exactly where it left off.
- **Recovery Time** (also called recovery window) refers to the length of interval that is acceptable between the time the incident affects the system and the time the system returns to operation. A short recovery time is most important in transaction-centric operations where real-time continuity is key, such as banks, airline reservation systems, and dot-com companies.

All businesses and systems share both of these concerns, but ordinarily one is more dominant than the other depending upon the type of business and the type of system within an organization.

How to Win Executive Support for Your DRP

Disaster Readiness Strategic Planning Guide, 03-Oct-00

Gaining senior management support is absolutely vital to successful DRP because its implementation requires cooperation from managers of all the departments of the company. Senior executives are, at least initially, unlikely to be receptive to your DRP efforts because it is a nonoperating expense that impacts the bottom line. It is precisely the bottom-line arguments, however, that you must use to convince them of the necessity of the DRP. After all, the DRP relates directly to the survival of your organization after a major system disruption.

There are a few things you must complete in advance before approaching senior executives. The first is a Business Impact Analysis (BIA). Although you may not have the whole Disaster Recovery Plan (DRP) ready, you must have this portion of it completed. Then you must collect historical facts about disasters that have affected your company and industry in the past. Next is to understand the legal data protection requirements and contractual obligations that bind your company. Once you have completed the BIA and gathered all the relevant facts, you are ready to make your case. Here are a few tips.

- Make a sound business case. A technical discussion won't be persuasive - a business discussion will. Focus on the impact to the bottom line and to your company's reputation following a system's outage. The BIA should help you assess issues such as the dollar impact of downtime by functional areas.
- Justify DRP related expenditures using statistics and facts. Use examples from your company's and industry's disaster history and highlight your company's lack of readiness for, and hence its ability to survive, a disaster.
- Review legal requirements, fiduciary responsibilities and liability. Digital data is an extremely important asset of your organization. Understand what your company's responsibilities are. If data is lost, executives may be liable and culpable.
- Understand contractual obligations. Most companies stipulate in their contracts that suppliers must deliver the services or products to their customers regardless of your companies problems or pay the penalties.
- Know the DRP costs and request funding for it. Don't leave it to management to figure out where the money for DRP will come from. Argue that the cost of DRP should be allocated across the whole business because nearly every aspect of the business relies upon computers.

Disaster Planning More Critical than Ever

Info-Tech Advisor, 11-Jan-00

Disaster planning. The bottom line is that it's one of the smartest business investments your company can make. It's even smarter still if you've stepped foot into the dynamic, and highly vulnerable, world of e-business. Take a look at these resources to help you refine your disaster recovery plan.

- The article "When Disaster Strikes" from NetworkMagazine.com takes an informative look at tape backup, electronic vaulting, data mirroring, and disaster recovery outsourcing, complete with links to product vendors and service providers.
- Arthur Andersen Consulting offers some business continuity planning best practices, as well as an interactive tool to rate your company's planning efforts.
- Smart Computing offers a brief article, "Data Recovery Services," which tells you what to do if you need to salvage data from a damaged hard drive.
- Finally, another article from Smart Computing called "Digital Data Disappearance" gives an interesting rundown on the life expectancies of different storage media. Really good information to know.

Yes, disaster planning can be expensive when you consider the cost of built in redundancy and the offsite storage of backup data copies you may never see again. Yet when compared with potentially crippling revenue losses that could stop your company in its tracks, disaster planning is a drop in the bucket that also offers unparalleled peace of mind.

Test Your Disaster Readiness

Info-Tech Advisor, 23-Feb-99

"Can your company recover from a computer systems disaster? Can you Prove It?" These are the two important questions being asked by Prove It!, an innovative new Web site that helps IS/IT Professionals and Business Executives evaluate and improve on their disaster recovery plans.

Prove It! offers an impressive collection of tools and resources that address both strategic and technical issues, including an industry standard Disaster Readiness Scorecard; a Plan Writer's Toolbox; a range of informative case studies and white papers; and links to products and services that can help you fully develop your disaster recovery solution.

The Prove It! Web site is a unique "must have" resource for any organization. We encourage you to take a good look at what Prove It! has to offer.

Note: This resource was updated on November 21, 2001. DLT Tape has updated the ProveIT page and renamed it "Data Protection Best Practices".

Disaster Recovery: Safe or Sorry?

Info-Tech Advisor, 26-Jan-99

If you don't have a "business-resumption strategy", just spend a minute and think about what a natural disaster could do to your company. Even though you may never need to use them, investing in disaster recovery initiatives may one day prove to be the best money you've ever spent. Here are some disaster recovery areas worth investigating.

- **SYSTEMS:** Not all systems are critical, so decide which systems and data are absolute necessities as incorporating non-critical systems into your recovery plan can lead to sizeable cost increases. Do you require a mirrored application that is ready to run or do you simply need to preserve your corporate data? Consider locating any back-up hardware in another city, as this will help reduce the number of common risks. How will you keep the back-up site current and up to date? How have new systems such as e-commerce and Extranet initiatives been incorporated into your disaster recovery plans? Have a look at these disaster recover plans created by IBM, Exodus and Comdisco in response to a Request for Proposal put forward by Network Computing. http://www.nwc.com/1001/1001f1.html

- **POWER:** Blackouts and temporary power outages are a fact of life. UPSs can give you anywhere from minutes to days of backup power depending on your needs. UPSs can even be connected to a file server, notifying users to save files and power down. Recent advances in local and remote monitoring and management have made UPSs much easier to use. Remember: "A UPS is only as good as its batteries," so seriously consider anything that will prolong battery life expectancy beyond the standard 2-4 years as well as management devices that let you know when battery failure is imminent. See the UPS Buyer's Guide at http://www.nwc.com/1001/1001buyers.html, which offers both Enterprise and Workgroup UPS product charts plus tips on properly sizing your UPS.

- **DATA:** Data Recovery Software will create tape backups of mission-critical data not only on mainframe systems and applications, but also on notebooks and application servers. By removing these tapes to a secure remote location, the chance of both the primary and storage sites being negatively affected by the same disaster are greatly reduced. Take a look at http://www.iweek.com/716/16iubkp.htm for a recent discussion of the features and uses of a variety of data recovery software products on the market. Also check http://www.nwc.com/920/920r2.html for a detailed look at enterprise backup applications, featuring a useful interactive Report Card.

How far you go to ensure system availability should be a function of how mission critical the application is, the cost of downtime, and your risk tolerance. Consider offering the CEO three alternative plans: one minimalist approach, a second recommended plan, and a third high availability option. It is possible to protect against 99.9% of all disaster risk -- the key is to pick what protection you require, what potential losses you are willing to suffer, and what you are willing to pay.

Lessons Learned From The Largest Project In IT History

Info-Tech Advisor, 11-Jan-00

The lessons learned from Y2K are too valuable to ignore. With other long-delayed projects banging at the door, you may feel that there is no time to sit and reflect on Y2K. Yet to get the most out of this unique event, you must conduct a post mortem NOW. Use the following five lessons to guide your analysis and get you thinking about your IT strategy for the coming year.

The Power of Project Management: Procrastination turned Y2K from a problem into a crisis. Hasty decisions translated into big mistakes and big expenditures.

- Lesson: The organization must adopt a proactive mindset. Project planning, task prioritization, the use of metrics, contingency planning, and the discipline to meet an unmovable deadline were key project management skills required by Y2K.

The Need to Track Inventory and Assets: Many IT managers discovered that their company owned hardware and software that wasn't on the books, turning compliance checks into a logistical nightmare.

- Lesson: A clear and accurate picture of the IT infrastructure and its assets, including software code, is essential before engaging in any project and allows for wiser investment decisions. Asset and configuration management are a must.

The Impact of Consistent Documentation: Changes are often made to software and systems with no paper trail explaining the 'hows' and 'whys,' making it harder to check for compliance. Often, the person that did it is no longer with the company.

- Lesson: Documentation is the only way to track changes and ensure that information on how it was done gets into the hands of the next generation of IT staff.

The Need to Streamline Vendor Relations: Some IT managers were surprised to find that their vendors weren't quick to offer the necessary Y2K fixes and upgrades, and some of the "changes" they made didn't actually work.

- Lesson:Y2K shone a big spotlight on the lack of quality vendor support. Datamation sums up the lesson learned here in a nutshell: "vendors would rather make a big concession than lose a big account." When it comes to vendor negotiations, be aggressive.

The Interrelationship Between IT and Business: Y2K is an IT problem that has nothing to do with business. It's a "techie" thing, right?

- Lesson: IT is a business enabler, and if IT fails, business fails. Y2K drove this fact home for many business executives. Business and IT must share common goals with business taking a leadership role in solving technological problems.

To get the ball rolling on your post mortem, take the following six steps:

1. Stave off pressure from others in the organization to "get on with things" by enlisting the support of a sympathetic executive sponsor.
2. Conduct your post mortem now while it's still fresh in everyone's mind and all the key Y2K players are all still with the company. If the Y2K situation in your company is unstable, hold a preliminary meeting now and do an in-depth investigation later in the year.
3. Break your analysis down into disciplines, such as testing, teamwork, and inventory management, to make it more manageable.
4. Don't focus exclusively on failures - identify successes too. Remember that successes can be translated into best practices to help guide future projects.
5. Look for 'reusables.' A lot of the work you and your staff did on Y2K needn't go to waste. Large parts of your Y2K contingency plan, for example, can be applied to your disaster recovery plan, so go ahead and integrate them.
6. Plan to present your findings to your CEO. Prepare a presentation in the form of action items. The lessons learned from Y2K have enterprise-wide implications, so go straight to the top to make sure they reach all levels of the company.

Disaster Planning: Options Analysis

The Essential Elements of a Disaster Recovery Plan (DRP)

Disaster Readiness Strategic Planning Guide, 03-Oct-00

The primary goal of all DRPs is speedy resumption of business as usual following a disaster without the loss of data that is crucial for normal functioning of business. The hallmark of a disaster tolerant system is that it consists of multiple sites that are sufficiently separated so as to ensure that a disaster at the primary location does not directly affect a secondary location or locations.

We may therefore identify the following essential elements of a DRP:

- **Regular Backup:** This is an obvious requirement. It involves making a copy of files from hard disk to tape for the purpose of retrieval in case the original is erased, copied over, damaged, or destroyed.

- **Archiving:** Archiving (or data vaulting) is the process of systematically making copies of your most current data and storing these copies in a safe, off-site location where they can be readily accessed if needed for restoration. Archiving is made necessary by the fact many catastrophic events have a geographic or physical dimension. That is, they might affect a city, or a region, or a building-or even an office or floor within a building. Archiving may be your only chance of recovery from a disaster if your on-site copy is unrecoverable.
  Depending upon your "recovery point" and your "recovery time" you may need to take additional measures such as electronic vaulting, mirroring, and online hot backup.

- **Risk Analysis:** The purpose of risk analysis is to evaluate and plan for the disasters that can be anticipated. For instance, is your company headquarters located in a hurricane-prone area, on a flood plane, in a heavy snow zone, or near a geologic fault? This means that your DRP must ensure that your archiving or recovery site does not share any common point of failure with your primary site. You must make sure that the two sites are geographically dispersed so they won't be prone to the same risk of natural calamities, utility infrastructure mishap, or civil unrest.

- **Business Impact Analysis (BIA):** Core to a good disaster readiness plan is a thorough understanding of which business functions are most critical to your company's survival so that they can be properly protected. The purpose of BIA is to determine the bottom line impact of systems disruption on specific functional areas within an organization. This helps determine the prioritization of recovery based on a function's level of criticality to business continuity and survival.

- **General Crisis Management:** This includes employee safety and how to cooperate with police, medics, fire fighters, and other emergency workers. See the InfoTech article "Crisis Management: How to Handle a System Outage" at http://www.infotechadvisor.com/search/

- **Recovery Phase Planning:** The recovery phase is that actual set of technologies, services, and procedures in the DRP that would be triggered if a catastrophe occurred and the recovery plan had to be implemented. This is an extremely important element since all of the plans and technology mean little if not implemented when needed.

Backup

Disaster Readiness Strategic Planning Guide, 03-Oct-00

Digital data is the lifeblood of business organizations; protecting it must therefore be among the chief security concerns of every business. Many things can harm data: viruses, equipment failures, or natural disasters. Because data is absolutely vital to your organization, you must protect it by making backups and storing them in a safe place.

1. Backup Levels and Methods

There are three backup levels that are used with various media rotation schemes: full backup, and two types of partial backups called incremental and differential. Full backups are made at longer intervals, such as weekly, or quarterly; the partial backups are usually made daily to save time and backup-media space.

- **Full Backup:** A full backup includes the entire system and all its files. Weekly, monthly, and quarterly backups are usually full backups.

- **Incremental Backup:** With incremental backup, only the files that have changed since the last full or incremental backup are backed up. Subsequent incremental backups only back up those files that have changed since the previous incremental backup.

- **Differential Backup:** With differential backup, every file that has changed since the last full backup is backed up each time.

On average, incremental backups take less time than differential backups because there are fewer files backed up each time. However, it takes longer to restore data with incremental backups than with differential backups since with incremental backups data from the last full backup plus data from all the incremental backups must be restored.

From a DRP viewpoint, differential backups are a better practice since it allows for a faster recovery.

Within these three levels, there are two methods of backup:

- **File-by-file method** requests each individual file and writes it on the backup tape. A "verify" option is provided: it requires that all copied data from the disk be reread from the source and compared byte by byte with the data on tape.

- **Image or disk mirror methods** take a snapshot of your disk and send the entire volume image to the tape, sector by sector. The process is almost seamless, allowing the tape drive to stream at maximum performance. Image backups provide a fast, full-system restoration.

2. Best Backup Practices

- **Centralize your backup system:** The control of backup processes may be distributed or centralized. Distributed backups rely on individual users who may not adhere strictly to the time-consuming and painstaking procedures. Local Area Networks (LANs) help the use of centralized backup procedures. This should be the preferred method since it provides the greatest control, follows a standardized process, is lower in cost and is on a centrally controlled computer.

- **Standardize on a uniform tape and software solution:** Centralized backup systems permit standardizing on a uniform tape and software solution throughout your company making backup and recovery easier and more reliable.

- **Have a standardized backup policy:** A standardized policy for backup and recovery should be developed, written, and deployed company-wide, including remote locations. This policy must be supported by senior management. The centralized backup system facilitates the implementation of standardized procedures.

- **Backup regularly:** Regular backup carried out in the framework of a media rotation scheme provides a depth of file versions to allow restoration of a file at a particular point in time, say, prior to virus corruption. A popular rotation scheme is the Grandfather-father-son (GFS).

  In GFS, "son" is the daily partial backup, "father" is the full weekly backup, and "Grandfather" is the full monthly backup. A total of 12 media sets are required: four daily, Monday-Thursday; five weekly, Friday week 1-5; and three monthly, month 1-3. The media is reused on the day, week, or month matching its label.

- **Make duplicate copies:** It is a good idea to make two backup copies in case of a problem with one of the backups. The second copy should be archived offsite for disaster recovery purposes.

- **Retire backup tapes regularly:** Since tapes are reused, they are liable to become damaged over time. They should have a retirement plan. The plan should include a time schedule, when soft-corrected errors exceed safe limits, or when they have been reused a certain number of times. Software is available that monitors tape and media problems and alerts people in time for safe replacement.

- **Back up mobile computer data:** Laptop and notebook computer data is at high risk of loss. Automatic network backups of mobile computers when they connect to your organization's network are the best solution.

- **Perform regular disk defragmentation:** Fragmented disk files take longer to back up because hard disks take longer to seek the data blocks that make up the files.

Archiving

Disaster Readiness Strategic Planning Guide, 03-Oct-00

Archiving is the process of systematically making copies of your most current data and storing those copies in a safe off-site location where they can be readily accessed if needed for restoration. Archiving may be your only chance of recovery from a disaster if your on-site copy is damaged or destroyed.

There must be a commitment from senior management to archive as an ongoing process, the central goal of which is to preserve the integrity of information. It must include a detailed cataloging and retrieval process for data recovery and restoration.

Archiving has some other benefits too. It provides ongoing data access for data mining, and it allows companies to fulfill legal or contractual obligations such as maintaining specific information for extended periods of time. From a resource perspective, it frees up disk space by creating an off-line version of old, static data that may still be needed.

1. Best Archiving Practices

- Handle media properly since physical damage is the most probable cause for tape failure. Avoid tape damage by always keeping hardware in good working order and properly handling, shipping, and storing media.
- Store tapes in clean dust free areas away from magnetic fields like those emanating from electronic equipment.
- Store tapes on edge, not flat, to preserve tape pack winding for proper playback.
- Store media in a cool dry place since low temperatures and low humidity significantly extend media lifetimes. It is a good practice to use specially designed media and storage containers for archives.
- Develop management policies governing how long to retain information. Certain important information may be stored forever. Legal requirements mandate that records be kept for certain time periods. To limit potential liability during disclosure in a lawsuit, it may be wise to destroy certain information once the legal time limit has expired.
- Plan for technology migration since all information storage media will degrade and newer generations of tape will replace older generations. Look for industry-accepted standards to ensure compatibility of media and interchangeability with other drives. Be wary of proprietary designs that are not open and may become obsolete. Make certain that tape-drive vendor guarantees backward read compatibility from generation to generation of its products.

2. Recovery Point and Recovery Time of Physical Vaulting

The typical DRP calls for a shipping schedule for tapes of backed up data. Full backups are shipped weekly and monthly depending upon the rotation scheme you employ; partial backups are shipped nightly. If a disaster occurs, the tapes are shipped to an alternate site and loaded onto a computer system so that the business operations can resume normally.

This scheme yields a recovery point of from zero to a maximum of twenty-four hours. If disaster strikes just after the nightly tapes are shipped, the recovery point is zero hours; if it strikes just before the nightly tapes are shipped, the recovery point is twenty-four hours.

It yields a recovery time or window of varying time intervals, depending upon how long it takes to ship the data from the archiving facility to the remote computer site, to load the data onto the computer system, and to troubleshoot the system and get things working normally.

If the alternate site is "hot" so that the entire computer and network infrastructure is already installed and only needs to be configured and fired up, this process could take forty-eight hours: twenty-four hours to ship the tapes, and another twenty-four hours to get everything working at the remote site.

More than seventy-five percent of systems and networks in the United States are backed up by shipping tapes around. For many businesses, however, twenty-four hours represents too much data loss and forty-eight hours too much downtime. Additional data protection and fast recovery measures are necessary for these organizations.

In deciding what additional measures are necessary, it is important to remember that data loss (recovery point) in the traditional scheme occurs because tapes are backed up and shipped to the archiving facility infrequently; downtime (recovery time) occurs because it takes time to ship the tapes from the archiving facility to the remote computer facility and to get things working normally there.

Depending upon the recovery point and recovery time objectives of your organization, you should take following additional measures to address these concerns.

Electronic Vaulting and Mirroring

Disaster Readiness Strategic Planning Guide, 03-Oct-00

Electronic vaulting refers to the process of backing up data over a network to a remote site. Its purpose is to achieve a more recent recovery point, i.e., to minimize data loss. With electronic vaulting, weekly and monthly full backup tapes are shipped to the archiving facility as usual; partial backups are sent electronically either several times in the course of a day or continuously; in the latter case only transactions that were processing when the computer went down may be lost.

Electronic vaulting, however, does not reduce the recovery window because the tapes still have to be shipped to the remote computer site and loaded.

Long recovery windows are unacceptable for many kinds of businesses such as e-commerce companies, banks, brokerages, and stock exchanges. These kinds of organizations need to be back up on their feet following a system failure in as little as a few seconds to well under two hours.

To achieve such short recovery windows, it is necessary to mirror data to an identical, dedicated system. A probe can then be installed on the protected machine that continuously sends "I'm OK" messages to the mirroring machine. If the probe sends out a distress call or simply stops sending messages, the mirroring machine kicks in. Theoretically, this provides for an instantaneous, transparent recovery.

Companies can achieve an even greater level of protection by continuously operating the two servers in parallel. In this setup, clients are transparently directed to whichever server happens to be most available at the moment. This multipath solution also offers higher performance during normal operations.

Mirroring and multipath solutions are most popular with financial institutions and e-commerce sites. Most other companies, however, do not find such techniques necessary for their operations. Archiving with physical transportation of tapes, combined with electronic vaulting for those with stringent recovery point requirements, suffices in most cases.

Recovery Phase Planning

Disaster Readiness Strategic Planning Guide, 03-Oct-00

Recovery is the final aspect of disaster recovery planning that ensures business continuity. A recovery plan can be said to be successful only if the planning for technology, services, and procedures results in a recovery exactly as planned.

The recovery phase in the case of an actual disaster would trigger the technologies, services, and procedures that are necessary for a successful recovery. Recovery planning must therefore include the following:

- Service agreements for rental or replacement equipment
- Service agreements for temporary hot sites
- Service agreements for mobile data centers with Disaster Recovery service provider if you outsource disaster recovery
- Plan for rapid release of vaulted data
- Staffing contingencies for backup sites and the activities required to get these sites up and running following a disaster

Disaster Recovery In A Post 9-11 World

Info-Tech Advisor, 27-Nov-01

The events in New York of September 11 have pushed disaster recovery and business continuity planning to the highest place on your agenda since Y2K. **Review your plans** and employ an "all hazards" approach. A key IT lesson from this terrible event is that DRP (disaster recovery planning) cannot be about the one-time deployment of a single technology.

For many organizations DRP is about data backup and restore. While important, backup and restore can't be your only focus. Here are a few DRP surprises experienced by organizations directly affected by September 11.

- Some organization's DRPs called for back-up data to be flown to emergency facilities that were many miles away. On September 11-15 all aircraft were grounded.
- Many emergency locations are designed for temporary use. Plans did not consider situations where the primary business location would no longer exist or for re-locating thousands of displaced workers.
- Emergency generators that were functional could none-the-less not operate because of dust and debris. Some sites, which were physically unharmed, remain off limits because of environmental safety concerns.

Action Plan: In reviewing your plans, here are some important steps to consider:

1. **An "All Hazards Approach"** Y2K planning forced you to ask questions such as "What if the computers work but the power grid goes down?" Disasters will rarely be so selective as to just affect your unit. Examine the assumptions you are making about essential services that you normally rely on.

2. **Support Displaced Workers** Create secure "work from anywhere" remote access for employees through a VPN. Contingency plans should include short and long term locations for displaced people to work.

3. **Support Communications**: Make sure your emergency facilities can support your crisis communications efforts. This includes telecommunications support as well as providing access to key data such as employee phone numbers. Communications is crucial to crisis management.

4. **Establish DRP Champion and Ongoing Program**. It should not take a major disaster, or threat of disaster, to wake everybody up to the importance of continuity planning. Make sure somebody in your organization has ownership of this issue and that your plans are reviewed regularly.

Bottom Line: Business continuity and disaster recovery planning should never be off your radar. Learn the instructive lessons of the September 11 disaster, but also make sure that this issue doesn't go to sleep until the next "wake up call". A crisis could happen anytime and in any form you can imagine (and some you can't).

Want to Know More:

- "DRP Lessons Learned After September 11, 2001" at ITAudit.org.
- "All Hazards Crisis Management Planning" at Disaster-Resource.com.
- "September 11, 2001 Aftermath: Seven Things Your Organization Can Do Right Now" at Disaster-Resource.com.
- "Assessing the Effectiveness of a Contingency Plan for an Individual Business Unit" at ITAudit.org (includes a Business Unit Contingency Plans Self-Assessment Questionnaire.)

Also download Info-Tech's "Disaster Recovery Planning: IT Decision Guide." This 50 page Adobe Acrobat document compiles our best advice, insights, and resources for developing a DRP.

Analyze the Potential Impact of Disaster on Your Business

Info-Tech Advisor, 11-Dec-01

Business Impact Analysis (BIA) allows you to assess the impact of a potential disaster on your organization. By applying BIA, you can:

- Identify mission critical processes and systems in your organization that are most vulnerable.

- Identify and classify the different types of threats.
- Spell out the financial impact of the loss of these processes and systems per time.
- Identify what's needed to get these processes and systems up and running quickly.
- Cost-justify your recommendations on how to minimize or mitigate risk of loss.
- Create a prioritized, detailed recovery strategy.

BIA is the most important step in your disaster recovery and business continuity planning process. Don't skip it.

Action Plan: Experts agree that there are four major steps in any BIA project. These steps *must* be followed in order.

1. **Plan the Project:** Lay out the goals, team members, scope, timeline, and deliverables of your project.
    - Use this stage to get a firm understanding of your company's business environment, priorities, and goals.
    - Include business managers on your team. If cooperation is a problem, remind them that this activity could save their job one day.
    - Above all else, get executive sponsorship. This is crucial for gaining both enterprise-wide support for your initiative and information gathering authority.
2. **Gather Your Data:** Collect information from participating managers and key users about what processes and systems are critical and why.
    - Prepare participant and function checklists so you can keep track of who you've talked to and what you've covered.
    - Pick you poison. There are a variety of techniques to gather your information, including questionnaires, interviews, and workgroups.
    - Ask questions that help you find out the quantifiable (e.g. financial) and non-quantifiable (e.g. reputation) business impact of not performing certain functions.
    - Validate all information by following up with participants.
3. **Analyze Your Data:** Identify the criticality of systems and processes, spot interdependencies, and assign dollar values. Pinpoint:
    - What will happen if business functions are lost (e.g. discontinuity of operations, loss of revenue, loss of reputation).

- Who will be affected by downtime or loss (e.g. suppliers, customers, staff).
- Which systems and functions are most critical to business operations (e.g. generate revenue), or could impede critical systems and functions if lost.
- How much it will cost to recover each function, and how fast recovery should happen for each function.

4. **Put Your Findings in a Report:** Present a textual and graphical summary of your analysis – including priorities and recommended controls – to senior management for review and approval. Keep the content non-technical – focus on dollars and cents. After this point, the decision to take action rests on their shoulders…

Other Considerations:

- Get buy-in from participating managers on your findings before presenting your final report. Gain consensus on priorities – otherwise, some may interpret your findings as a declaration that one department is more important than another.
- Update your BIA yearly.
- Automated BIA tools can dramatically shorten the timeframe on you BIA project. See CrossNodes' "Gauging Potential Disaster Impact" for questions to ask BIA software vendors.

Bottom Line: The amount you invest in a system or process to protect and restore it must be commensurate with its worth. Conducting a BIA offers you a clear and impartial method for showing senior management where your organization should spend its disaster prevention and recovery dollars.

Want to Know More?

- The Super DLTtape Web site has a fantastic Business Impact Analysis section, complete with sample questionnaires and even a sample memo you can use to announce your BIA project.
- Also see the SANS Insitute's "Business Impact Analysis for the Security Professional" for a good overview of the major BIA issues and steps.
- For survey findings on current practices in business continuity and disaster recovery planning, read InformationWeek.com's "Playing For Keeps."

Physically Protect Your IT Assets

Info-Tech Advisor, 18-Sep-01

By protecting its facilities, inventory, and other physical assets, nearly any company in any industry can reap the benefits of a remote monitoring system. Introducing Sensaphone Scada 3000, a fully integrated control system meant to ensure your company's protection.

Main Features:

- **Data Logging:** User-programmable, built-in data storage for I/O points or calculated values.
- **Event Logging:** Internal tracking of alarms and events
- **Web Page Generation:** Software to upload I/O status and alarm data as a customizable Web page to the URL of your choice.

For more information, including pricing, be sure to check out the vendor Web site.

White Paper: Securing Info Assets

Info-Tech Advisor, 20-Feb-01

If your IT department is struggling to create a security policy that protects your company's critical information assets, then be sure to take a serious look at this 98-page white paper, "Practices for Securing Critical Information Assets," from the Critical Infrastructure Assurance Office.

In this white paper you'll find chapters on:

- Establishing Information Security Policy
- Identifying Critical Assets and Conducting A Vulnerability Assessment
- Tools and Practices for Critical Information Asset Protection
- Security Incident Planning

Also look into this resource if you need a security checklist, policy templates, and survey information.

Physically Protect Your Servers

Info-Tech Advisor, 15-May-01

Regardless of your company culture, physical access to the server room should be monitored and controlled. The server room is one of the most important physical places in an organization and should be secured as strongly as your corporate data.

Startling Lack of Server Room Security: Seventy companies were surveyed by TechRepublic to determine how seriously server room security is treated.

- 21% of companies share their server room with general storage for the organization.
- 29% report that their server room doubles as someone's office.
- 35% have a server room used solely for that purpose, but the room is not secured.
- 8% have server equipment out in the open with no dedicated room whatsoever.

Small Versus Large: The problem of unsecured server room access is generally a "small business" problem. This is mostly because small organizations have to make due with the space that they have.

Action Plan: Use any or all of these three methods to mitigate the risks involved with open access to your server room.

1. **Keep the Door Completely Closed:** Although this sounds quite simplistic, it is a proven fact that keeping the door closed could prevent most people from going in. Just by having the door closed, you impart a feeling to employees that they should not be poking around in the room.
2. **Lock and Key Solutions - Small and Medium Businesses:** Lock and key solutions are a simple way to resist unauthorized access, especially for small- and medium-sized businesses that must restrict access, but don't wish to spend vast amounts of money. Keep a running record of original and copied keys, and be sure to collect server keys before terminating any of your employees.
3. **Get Access Control Cards - Large Businesses:** Access control card systems offer the greatest return to large enterprises. These are full-featured systems that grant or deny a set of rights to each card. Cards cannot be duplicated and are only usable by the designated cardholder.

Strategies for Preventing Server Room Mishaps: Effective security measures may help prevent unwanted access, but authorized IT staff can cause some of the most dangerous incidents in the server room. Enforce these server room rules across the board:

- Don't smoke in the server room, including after hours.
- Disallow any food or beverage in the server room.
- Keep the door shut for both security and climate control reasons (The server room should be dry and at less than standard room temperature.)
- Be sure that the server room is not in the sight lines of windows or the reception desk.
- When deciding which room to use for servers, ensure that any high voltage sources (electrical boxes) are not located in adjacent rooms. If they are, make sure they are shielded.
- No water piping should run in the walls of your server room.

- Pick a central location for easy wiring

Bottom Line: A well-secured company means more than just high-tech firewalls and virtual private networks. Take a close look at who has physical access to key components of your hardware infrastructure and restrict unauthorized access.

Want to Know More?

- Start by reading "Control physical access to your server room" by TechRepublic.
- Visit U-NET's Security Online Web site.
- Finally, see a PowerPoint slide from MOREnet entitled "Control Physical Acc

Its Time to Build an Incident Response Team

Info-Tech Advisor, 30-Oct-01

Virus infiltration and hacker attacks are becoming near-daily occurrences for many networks. In the event of a breach, a well-planned and well-rehearsed Incident Response Team (IRT) is your primary tool in reducing downtime and getting your company back to a normal routine.

Action Plan: Use these tips to help you form your IRT and Standard Operating Procedures (SOP).

1. **Staff Your IRT:** Ideally, your IRT should consist of three to five people, but may be larger or smaller depending on how quickly systems need to be restored.
    - Designate a central contact person who ensures that the right people are contacted, decisions get made, and procedures are followed to the letter. This person must have the authority to gather all necessary resources to help contain the incident.
    - Designate a backup person for every position on your IRT. Incidents can happen any time - don't wait until a key team member is on vacation to discover this fact.
    - Know that different incidents will require a different chain of events, and different personnel. Over staff your IRT to meet the management and technological requirements of every conceivable breach. Remember that not every member of your IRT will be used for every incident. See the SANS Institute's "CodeRed II: Incident Handling Process and Procedures" for a list of key skill sets.
2. **Make Your SOP Crystal Clear:** An SOP (Standard Operating Procedure) is a concise listing of all tasks to be done and decisions to be made during an incident, laid out in the order in which they must be completed. It states exactly what constitutes an "incident" and what can and cannot be done. Everything your IRT needs to know must be here. It also serves as a useful document when downtime during an incident needs to be justified to senior management.

- Use your SOP as a checklist during an incident to ensure correct sequencing. If followed, every member of the IRT should know exactly where everyone else is in the procedure, facilitating status reporting.
- Keep all IRT member contact information current, and constantly review your SOP for accuracy. An out-of-date plan is worthless.

3. **Train Your Team:** Mock drills are the best way to train your team and to spot difficulties in your SOP. If the plan is second nature to the team, errors can be avoided and recovery time hastened.
    - One major area of focus should be on accurate documentation at the time of incident notification. It's amazing how often this simple step gets botched. Include this Info-Tech Incident Log Form in your incident response arsenal.
    - Also teach your team the value of discretion. Security breaches are sensitive - disclose information about an incident strictly on a "need to know" basis.
4. **Educate Your End Users:** Short of having an incident response procedure, educating your end users is probably the most important step you can take. End users are often the inadvertent cause of many security breaches since they don't fully realize the sensitivity of the information they're handling. As a result, they are also your first line of defense.
    - Get them up to speed on all security and appropriate use policies in place in your organization. Do whatever it takes to get the message across.
    - Drill them on the incident response procedure so that they know exactly what steps to take and who to contact.
5. **Learn Your Lessons:** Always prepare a post-incident report that includes details on who did what and when. Also estimate the impact the incident had on the organization in terms of personnel and equipment resources, as well as dollars spent or lost. This information is critical if litigation ensues, and helpful for convincing senior management of the need for a tighter security infrastructure.

Excellent Resources:

- "Handbook for Computer Security Incident Response Teams (CSIRTS)" from the Carnegie-Mellon Software Engineering Institute.
- "Forming an Incident Response Team" from the Australian Computer Emergency Response Team.

Bottom Line: Always be prepared for a worst-case scenario - it's significantly easier to scale down a plan than to try and scale it up at the last moment.

Want to Know More?

- See these insightful articles from the SANS Institute:
    - "Computer Security Incident Handling: Step-by-Step"
    - "Information Security: Handling Compromises"
    - "Incident Handling: The Art of Containing Compromised Information"
- Also read IT Professional's "A Practical Approach to Enterprise IT Security" for an overview of preventive, detective, and responsive measures.
- Finally, see "Avoiding the Trial-by-Fire Approach to Security Incidents" from SEI Interactive.

Purchasing and Implementation Issues

Prevention vs. Cure: It's Time for Online Backup

Info-Tech Advisor, 16-Oct-01

Up to 60% of your company's data may currently sit unprotected on PCs and notebooks. For an affordable price, you can keep your mission critical notebook data safe, secure, and readily available anywhere. Consider online backups as a convenient solution to a problem that has been emerging as more and more of your machines are disconnected from the central server.

Definition: An online backup can be done over any Internet connection using software usually supplied by a vendor. Data is saved to a server owned either by you or by the service provider.

The chance of your laptop being stolen this year is one in 10. The chance of it failing is one in 15. **Here's what you need to know to protect the data on your remote machines:**

- **Security:** Most companies offering online backup services will encrypt the data before it leaves your PC. For example, Connected uses Triple DES encryption, which they claim has never been cracked.

- **Convenience:** Online backup services can be completely automated, or set up to be as easy as a single mouse click.

- **TCO Savings:** Drive your notebook or PC Total Cost of Ownership down significantly using online backup products such as PC migration (a tool to preserve PC customizations over an operating system upgrade), remote control, asset discovery, and "anytime, anywhere" access to files.

- **Affordability:** Prices start from as low as $3 per month for 50 MB of storage. An average corporate price for a complete package of products is under $200 per computer, per year, for 100 GB of storage space, unlimited access.

Vendor Case Study: Connected TLM 6.0 is a full package of backup-based services, support, and training. In a scenario of two hundred users (volume discounts apply), the price per seat would be:

- $118 U.S. for the software, using your own server (plus data center server costs), or

- $189 U.S. per year for the service, using Connected's servers.

Action Plan: To reduce the amount of mission-critical data that currently lies unprotected on your users' PCs and notebooks, do the following:

1. **Try out a free evaluation** of an online backup service vendor. Get started at one of the following sites that offer a 30-day free trial:

    - Connected

- @Backup
- IBackup

2. **Write and distribute a policy statement** with regard to responsibility for backing up critical files. See Info-Tech's "Backup Policy" introduction and sample to help guide the process. For an example of a government White Paper on this topic, see "Recordkeeping Requirements for Electronic Research and Development Notebooks."

3. **Be aware of alternatives** for backing up notebook data. For a comprehensive discussion of the technical issues with regard to ZIP drives, CD-ROM, DVD, and external hard drives, see Dell's "Removable Media Storage Devices."

4. **Read Your Terms of Agreement** carefully. Be sure to ask your vendor the obvious questions about their own security arrangements, including server redundancy and off-site backups.

Bottom Line: Online backup offers the convenience of zero-maintenance, and may be your best choice if you have multiple computers unconnected by a central server. For a reasonable annual price, you can get unlimited storage and access from anywhere in the world.

Want to Know More?

- Read techguide.com's "A Moving Target: Data Protection for Mobile and Remote Workers" (free registration required).
- Also see Dell's "Removable Media Storage Devices."
- Take a look at Lakeview Technology's "7 Questions: Issues Concerning Managed Availability of Data and Applications."
- Finally, read Contingency Planning & Management's "Crucial Care for Vital Records" and "Your Data Protection Plan: Where It Should Be and How To Get It There."

A Paranoid's Guide to SQL Backups

Info-Tech Advisor, 30-Oct-01

"Hope for the best but plan for the worst" is the mantra of all good contingency planners. For SQL database maintainers, planning for the worst means having a solid backup solution in place.

A SQL Server pro and self-described "paranoid" has put together a series of 10-Minute Solution articles for DevX on backing-up SQL. Use these to practice a bit of healthy paranoia in your shop. The articles include:

- "Paranoid and Proud Of It: Part I" sets the stage with some horror stories of SQL backup errors and some basic ideas on mitigating risk.

- "Paranoid and Proud of It: Planning Your Backups" takes you through the basic questions you have to ask in developing a backup strategy.

- "Creating a "Complete" Backup Solution" answers the question "How do you create a truly effective backup solution? You have to plan for anything that could go wrong in your system."

Other articles on the topic of SQL backup include: "Using SQL Server 2000 Recovery Models," "Choosing the Right Backup in SQL Server," and "Restoring Your Database Safely."

In contingency planning, it is healthy not only to think that it could happen to you, but also that it *will* happen to you. Are you ready? It might be a good time to go over your backup procedures with your DBA.

Tips for Safe Data Recovery

Info-Tech Advisor, 25-Jul-00

"More data is lost every year to failed recovery attempts, than to actual breakdown or malfunction." - Datarec.com

No matter how comprehensive your data backup strategy, you may still be faced with potential data loss due to a virus, hard drive crash, or natural disaster. If critical data is at stake, your first, last and best line of defense is a reputable data recovery service.

Buyer Beware! Data recovery is a highly skilled, delicate, and painstaking process. Poor procedures or techniques could destroy previously recoverable data. You only have one chance.

Be picky and skeptical when selecting a data recovery service. If done well, almost all of your data should be recoverable.

- Don't trust Web site or sales rep pitches - get references from previous clients.

- Data recovery has physical and logistical limitations caused by factors like heads coming into contact with the media or highly fragmented disks. Don't believe claims of a consistent 90-95% success rate - be suspicious.

- Do a thorough background check of all technical staff to ensure expertise.

- If you have an unusual hardware or software platform, make sure they have the facilities and expertise to handle it.

Choose a service based on what they can do, not where they are.

- There are only a small handful of reputable data recovery services in the world. Ship your damaged media to the best service provider, regardless of where they are - shipping will have little impact on the restoration timeline.

Use file recovery utilities cautiously. If you do decide to go it alone, only attempt data recovery if the problem is minor and the drive has been recently backed up.

- If you suspect electrical or mechanical failure, using a software utility like Symantec's Norton Utilities or Microsoft's ScanDisk may "fix" data or destroy it, making it irrecoverable. Back up, shut down, and call the experts.

Bottom Line: Data recovery is extremely expensive, but when compared to the cost of lost data, it's worth it. However, prevention is better than cure - a comprehensive and thoroughly tested backup regimen is still the best and least expensive way to ensure data safety.

- Visit Data Recovery Lab's list of data recovery services . Also see their helpful service selection checklist.

- See Ontrack's Data Protection Guide for tips on protecting data and storage media, as well as methods for ensuring successful recovery.

Should You Outsource Disaster Recovery?

Disaster Readiness Strategic Planning Guide, 03-Oct-00

The cost of disaster preparedness depends upon the volume of data your business generates everyday, and upon your recovery point and recovery time objectives. "Backup only" is the minimum protection every firm must have, no matter what its size. "Backup only", however, does not protect you from natural disasters, when your business premises are badly damaged or destroyed. Disaster preparedness at the minimum calls for tape archiving through regular, scheduled transportation to a site not vulnerable to the same natural catastrophes as your primary site.

As we have seen, further measures are necessary depending upon how much data loss and downtime your business can tolerate. If you need a very recent recovery point, but you can tolerate a lengthy recovery time, then tape archiving supplemented with electronic vaulting is minimally essential. In the event of a disaster, you have taken the calculated risk that your primary business premises can be restored within a reasonable length of time. Those with narrower recovery windows must make further arrangements, such as having a "hot site" that is ready to accommodate all business operations. This means not only hardware readiness but also trained-people readiness to man the "hot site."

The above considerations are common to disaster preparedness whether you decide to implement DR in house or outsource it, and the relative magnitudes of the costs of different plans will be the same in either case.

There are arguments for and against in-house DR; none of them are, however, definitive. Resources, estimated to be between five and eight percent of total IT budget, must be devoted to DR regardless of your choice between the two alternatives. The real question is whether you are willing to enforce the strict discipline in house and train your own personnel necessary for disaster preparedness.

If you decide to outsource, you should look first at the services offered by three large reputable firms, who hold ninety percent of market share in this business. These are:

- Comdisco Continuity Services at www.comdisco.com

- IBM Business Continuity and Recovery Services at www.ibm.com/services/continuity/

- SunGard Recovery Services at www.e-recovery.com

Outsourcer Failure: Be Prepared

Info-Tech Advisor, 12-Jun-01

In the summer of 2000, Gartner Group predicted that 60 percent of current application service providers would go under by 2002. A recent CommerceNet survey also found that 73 percent of firms currently outsource or plan to outsource. Do the math - your organization stands a high risk of being burnt by outsourcer failure.

An Outsourcing Survival Plan: The key to surviving outsourcing failure is to envision failure from the start. This may sound grim, but approaching each outsourcing arrangement as a marriage with the potential for divorce will get you thinking about contingency plans.

1. **Practice Due Diligence:** Getting a full, realistic picture of your proposed outsourcer's status is central to minimizing nasty surprises. See eWeek's "When ASPs go sour" and Comdisco's "The ASP Option: Opportunities, Issues, and Risks" for more due diligence tips.

   - ***Scrutinize your outsourcer's financials and business model.*** Who are their major investors, what's their attitude toward time-to-profitability, and what changes to operations have they made? Avoid organizations that are based on free advertising-supported services.

   - ***Watch for signs of merger or acquisition.*** At the very least, such plans do not bode well for customer service.

   - ***Analyze your outsourcer's customer base.*** Those that rely on business from dot-coms are in a potentially precarious position.

   - ***Include a clear exit strategy in every contract.*** Make sure you own your data and have a plan for obtaining, backing up, and transferring it. Also have a plan for buying and transferring ownership of software licenses.

   - ***See if the outsourcer has its own failure contingency plan.*** Do they have deals or strategies for migrating customers to another provider? Ask them what they think of the recent rash of failures in the ASP industry and have them show you what they have done to prevent it from happening to them.

2. **Be Ready to Move Fast:** In the event that your outsourcer closes up shop, follow these strategies to minimize business disruption.

   - ***Contact the outsourcer*** to find out the level and extent of support you can expect. Ideally, you should already know their failure contingency plan.

   - ***Contact other customers.*** They may be privy to information that you're not, or have a creative fallback strategy in place that may help you move more quickly.

- ***Take a second look at your second choice outsourcer.*** Have they made progress since you last looked at them? Keep this connection open just in case and keep their contact information on hand.

- ***Double-check your data.*** You should be keeping backup copies of all data that you send to a provider anyway, but ensure that you can get to it fast.

- ***Have emergency resources on hand.*** If you're forced to bring your outsourced services in house, you may need to bring in extra short-term staff or buy extra hardware and software at short notice.

Top Outsourcing Resources:

- Read Comdisco's "The ASP Option: Opportunities, Issues, and Risks" for an ASP overview and excellent risk management recommendations.

- Also check the Information Technology Association of New Zealand's "Outsourcing Guidelines" for a superb checklist on seeking and cementing outsourcing relationships.

- Finally, see Michael F. Corbett & Associates' 15-page "Best Practices in Managing the Outsourcing Relationship" for building better agreements.

Bottom Line: If it's really important to the basic functioning of your business, don't outsource it. Also, avoid locking yourself into multi-year contracts - you could end up eating the costs. Treat the potential failure of an outsourcing relationship as you would any other disaster - always have a contingency plan.

Want to Know More?

- Read InfoWorld.com's "The honeymoon is over" for more on exit strategies.

- Check out ZDNet Australia's Biz & Tech article "Weathering the ASP shakeout."

- View the results of the CommerceNet survey at "Outsourcing in Uncertain Economic Times: Business Survey."

Documentation: Get Up to Speed and Stay There!

Info-Tech Advisor, 20-Feb-01

The benefits of a strong documentation system are simple - it saves time and money by getting information about processes, routines, and infrastructure into the hands of those who need it more quickly. Is your documentation highly accessible and easy to use? Do you even have a documentation system in place?

Action Plan: Ask yourself what jobs have only one person who knows how to do them. If you don't know, find out - this will be a main indicator for how badly you need a documentation plan. Use these tips from TechRepublic's Meredith Little to get you started:

1. **Limit your Scope:** A full-scale documentation project involves interviewing key knowledge holders and could take up to a year to complete. Start small - document critical processes or those for a single department first to see what's really involved.

2. **Pick a Format:** Is your documentation going to be in print, online, or both?

   - ***Print*** - Good for detailed, lengthy procedures that don't change much. Requires a centralized physical repository or library.

   - ***Online*** - Good for modular projects, or for information that changes often, is only accessed occasionally, or requires customization for different groups. Requires an intranet and must be legible as a print version.

3. **Get the People:** Do you have in-house technical writers? If you do, know that writing documentation takes time and hiring temporary staff to offset the workload might be a good idea. If you don't, outside expertise is essential for quality results. Regardless, you also need to plan staffing for ongoing maintenance.

4. **Get the Tools:** Word (print format), HTML (online format), and Adobe Acrobat .pdf files (both formats) are the most common ways to create documentation. If more than one person will be updating documents, version control software is also a must (e.g. Microsoft Visual SourceSafe).

5. **Advertise:** You've put a lot of work into creating your documentation - make sure people use it! Anything from a simple e-mail to full training may be required to get the word out.

Bottom Line: Avoid reinventing the wheel. A good documentation system can achieve benefits as simple as allowing key staff to take time off without causing a crisis.

Want to Know More?

Read TechRepublic's three-part series on getting an internal documentation project off the ground:

- "How to get started on your company's internal documentation project,"
- "Internal documentation: Avoiding critical mistakes," and
- "Refining and maintaining your internal documentation project."

Also take a look at Andrew Oram's white paper "Methods and Mechanics of Creating Reliable User Documentation" for tips on building technical user guides.

Your Strategy for Stored Data Recovery

Info-Tech Advisor, 20-Mar-01

The stats on losses due to system downtime are staggering. These per company averages from a recent META Group survey prove the point:

- **Energy and Telecommunications** - $3 million per hour of downtime.
- **Manufacturing and Finance** - $1.5 million per hour of downtime.
- **Healthcare, Media, and Travel** - $330 to $636 thousand per hour of downtime.

Every organization needs to have a strategy in place to adequately protect and restore their mission-critical data in the event of disaster or downtime.

Action Plan: Network Computing sent a Request for Information (RFI) for a fictional company to a number of storage disaster recovery service providers, including Hewlett-Packard, IBM, SunGard, Exodus Communications, and Storability. While Storability was the best match for this scenario, Network Computing noted some key across-the-board omissions. Get answers to these questions before signing any agreement:

1. ***How is the data protected from eavesdropping*** when it's transmitted over networks to remote mirrors or tape vaults?
2. How is the data protected from unauthorized access by the vendor's own staff?
3. How are your existing data segregation schemes and access policies translated to the recovery environment?
4. What is happening to ensure that your data can be recovered intact when you need it on an ongoing basis?

Key Consideration: Most storage disaster recovery solutions focus on backup. However, the key to effective recovery is how quickly you can restore and use your data. Make this a primary consideration when selecting a recovery solution.

Vendor Offerings: You need to select carefully from the diverse range of solutions available. In addition to the vendors mentioned above, also check out these providers:

Comdisco Continuity Services
eDeltaCom Storage Management Services
NaviSite Managed Storage Solutions

StorageNetworks BackPACS Services
WorldStor Atlas Replication

Also check out Disaster Recovery Journal's Disaster Recovery Product/Services Internet Directory for a decent list of recovery vendors and service providers.

Bottom Line: Most companies cannot afford full redundancy. Identify your mission-critical data and work to protect it first. Remember that if you don't have a sound storage management strategy in place, a disaster recovery solution will only be that much harder and more expensive to implement.

Want to Know More?

- Check out Network Computing's "RFI: Storage Disaster-Recovery Services." This will give you a comprehensive overview of what to look for in a solution.

- Also take a look at Network Computing's companion article "Storage Disaster: Will You Recover?" for a good breakdown of backup and restore speed as well as an explanation of symmetric versus asymmetric disk mirroring.

Tips for Safe Data Recovery

Info-Tech Advisor, 25-Jul-00

> *"More data is lost every year to failed recovery attempts, than to actual breakdown or malfunction."* - Datarec.com

No matter how comprehensive your data backup strategy, you may still be faced with potential data loss due to a virus, hard drive crash, or natural disaster. If critical data is at stake, your first, last and best line of defense is a reputable data recovery service.

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Choose a service based on what they can do, not where they are.

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Use file recovery utilities cautiously. If you do decide to go it alone, only attempt data recovery if the problem is minor and the drive has been recently backed up.

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Bottom Line: Data recovery is extremely expensive, but when compared to the cost of lost data, it's worth it. However, prevention is better than cure - a comprehensive and thoroughly tested backup regimen is still the best and least expensive way to ensure data safety.

- Visit Data Recovery Lab's list of data recovery services. Also see their helpful service selection checklist.
- See Ontrack's Data Protection Guide for tips on protecting data and storage media, as well as methods for ensuring successful recovery.
- For information on diagnosing the severity of your drive problem, see DiskTech's page on Data Recovery.

Crisis Management: How to Handle a System Outage

Info-Tech Advisor, 21-Sep-99

> *"A recent survey of Fortune 1000 network administrators revealed that over 69% said they could not suffer a network outage of 60 minutes"*
> - from "The Effects of Network Downtime on Profits and Productivity," Performance Technologies, Inc.

A system outage can easily turn into a public relations nightmare for your department. End-users have high availability expectations, and downtime can not only result in a call center flooded with complaints, but more seriously, lost productivity, lost revenue, and lost shareholder support. The truth is that no system is bulletproof, and as systems grow more complex, so do the potential points of failure.

When a failure hits, you have two choices: to handle it well, or to handle it poorly. If dealt with properly, a failure can become a great PR opportunity. Here are eight tips on how to turn an outage into a victory.

1. ***Have a well-formed, up-to-date, and practiced crisis management plan in place***. Keep in mind that things will be hectic, so make sure your plan is "crisis friendly" i.e. easy to understand when people are highly stressed. Use easy to follow flowcharts and place key data and information at the front.
2. ***Have error logging and audit trail information at your fingertips***. Ensure key diagnostic information is centralized and easily accessible so that problems can be identified quickly.
3. ***Ensure that each team member knows his or her role during a crisis***. List roles by individual tasks and functions, not by the individual's name - people come and go. If people don't know their roles, precious time will be wasted, mistakes will be made, and a bigger crisis could flare up.
4. ***Have a tightly scripted notification procedure***. This will let your staff contact the right people at the right time based on the problem's severity. Notification will go beyond IT staff to other departments with affected business-critical operations. Establish these communication paths in advance.
5. ***React quickly and confidently according to the tested plan***. Time means money, and the speed or your response reflects professionalism and preparedness.

6. ***Inform customers and end-users immediately of what's going on and keep them posted***. Don't try to hide it - after all, the end-users probably knew before you did that there was a problem. If you cover up, you'll only lose their confidence and risk public attack. Be direct, honest, and accessible - lying, defensiveness, or saying "no comment" will kill your reputation. Identify mass notification routes in advance, like PA systems and voice mail, to spread the word efficiently.

7. ***Control blame and take ownership of the outage***. Every action you take will be in the spotlight. Blaming others is neither classy nor action-oriented. If the downed system is outsourced (such as Internet access), finger pointing will be tempting. Don't do it! Remember that even thought the problem may not be your fault, it is still your responsibility.

8. ***Always remember good customer service, whether it's in dealing with the public or corporate staff***. Crisis management efforts should always focus on the customer. Making a public pledge to prevent similar outages and outlining the measures you will take will be seen as a gesture of goodwill, help reassure those affected, and restore confidence in your service.

Fixing a problem isn't enough - it must be fixed quickly and confidently while maintaining a helpful flow of information to those affected. It may seem strange, but a well-handled crisis will not only help minimize negative fallout but will even boost your reputation. Revise your current plan and practice, practice, practice! Check the following resources for more information:

- A great crisis management guide, "Business Continuity Management - Preventing Chaos in a Crisis," at the UK Department of Trade and Industry.
- The Disaster Resource site for a collection of materials on crisis management and effective communication techniques to apply during crises at http://www.disaster-resource.com.

Supplemental Resource Library

The good news about disaster recovery and business continuity is the abundance of high-quality resources available on the Internet. Here is a compilation of some of the best online resources to help you with your own disaster planning initiatives:

Purchasing & Decision-Making Resources	• Vendor Directory from The Disaster Recovery Journal. • Disaster Recovery Yellow Pages from Disasterplan.com. • Business Continuity Plan Generator and Disaster Recovery Toolkit products from The Disaster Recovery Shop. • Disaster Recovery from ZDNet UK to help you decide on your data backup solution. • A comparison of Storage Disaster Recovery Services from Network Computing.
Implementation Resources	• A 10 Step Disaster Recovery Checklist compiled by PLAN and DPIC (.pdf download). • Directory of business continuity resources from BNA focusing on the healthcare sector.
Comprehensive Sources	• The Disaster Recovery Journal • Availability.com • LabMice.Net (Editor's Choice) • Disasterplan.com • Disaster-Resource.com • Drplanning.org • Global Continuity
Key Surveys and Statistics	Need ammunition for your business case? Check out these statistics: • The Safeware Insurance Agency Hardware Loss Statistics at the storagesearch.com. • Statistics and poll results at the NDR Web site. • Key statistics on power and telco outages at the drplanning.org Web site.

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Guide to Securing Microsoft Windows 2000® Terminal Services

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Warnings

- **Do not attempt to implement any of the settings in this guide without first testing in a non-operational environment.**
- This document is only a guide containing recommended security settings. It is not meant to replace well-structured policy or sound judgment. Furthermore this guide does not address site-specific configuration issues. Care must be taken when implementing this guide to address local operational and policy concerns.
- The security changes described in this document only apply to Microsoft Windows 2000 systems and should not be applied to any other Windows 2000 versions or operating systems.
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- This document is current as of July 2, 2001. See Microsoft's web page http://www.microsoft.com/ for the latest changes or modifications to the Windows 2000 operating system.

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Introduction

The purpose of this guide is to provide the reader with security guidance to support the design and implementation of Windows 2000 Terminal Services (WTS). This guide provides step-by-step instructions to perform many of the tasks recommended to secure WTS. Because WTS implementations will vary, system administrators and network managers should choose appropriate security settings for their environment.

The *Guide to Securing Microsoft Windows 2000 Terminal Services* presents detailed information on how to secure this service in a network environment.

WARNING: This guide does not address security issues for the Microsoft Windows 2000 operating system that are not specifically related to the Windows 2000 Terminal Service and its implementation.

This document is intended for Windows 2000 network administrators, but is beneficial to anyone involved or interested in Windows 2000 or network security.

Getting the Most from this Guide

The following list contains suggestions to successfully secure the Windows 2000 Terminal Service according to this guide:

WARNING: This list does not address site-specific issues and every setting in this book should be tested on a non-operational network.

- Read the document in its entirety. Omitting or deleting steps can potentially lead to an unstable system and/or network that will require reconfiguration and reinstallation of software.
- Be aware that while most of the security guidance applies to WTS in application sharing mode and in remote administration mode, there is some guidance that is unique to each mode. Care must be taken to ensure the correct guidance is applied.
- Perform pre-configuration recommendations:
  - If not using a new server, perform a complete backup of your server before implementing any of the recommendations in this guide.
  - Ensure that the latest Windows 2000 service pack and hotfixes are available to be installed. At a minimum, this includes Microsoft Windows 2000 Service Pack 2. For further information on critical Windows 2000 updates, see the Windows Update for Windows 2000 web page http://www.microsoft.com/windows2000/downloads/default.asp.

About the Guide to Securing Microsoft Windows 2000 Terminal Services

This document consists of the following:

Chapter 1, "Windows 2000 Terminal Services," introduces Windows Terminal Services (WTS) and describes three potential operational scenarios for WTS. The three scenarios include using WTS to support application sharing on an internal network (Intranet), using WTS to support remote administration of Windows 2000 servers, and using WTS to support application sharing on the Internet. Chapter 1 also describes the test network configuration that was used to develop the security guidance in this document.

Chapter 2, "Security Guidance for Windows 2000 Terminal Services," provides security guidance for implementing Windows 2000 Terminal Services (WTS). Guidance is provided for WTS when it is used for sharing applications on an internal network (Intranet) and when it is used for remote administration of Windows 2000 servers on an internal network (Intranet). The guidance covers WTS installation, configuration, file permissions, auditing, and router/firewall settings.

Appendix A, "Limiting Access to Applications," provides security guidance on restricting user access to applications when using WTS for sharing applications on an Intranet.

Appendix B, "Windows 2000 Terminal Services Default User Settings," identifies the default settings that Windows 2000 assigns to a WTS user.

Appendix C, "Windows 2000 Terminal Services Security Guidance Troubleshooting," contains a list of common problems that can occur, when implementing WTS with the security guidance specified in this document, and potential solutions to those problems.

Appendix D, "References," is a list of references used in developing the WTS security guidance.

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